THE

ELECTRICAL REVIEW.

VOL. LIX. NOVEMBER 30, 1906. No. 1,514.

ELECTRICAL REVIEW.

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1907 Edition

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Advertisements, new names and corrections to existing entries should be sent in at once.

SINGLE-PHASE TRACTION.

A PAPER with the above heading was read at the Institution of Civil Engineers by Mr. Charles F. Jenkin (of Messrs. Siemens Bros.), on November 13th, the discussion being continued and closed on the following Tuesday. In this connection it will, no doubt, be remembered that Mr. Jenkin's brother, who is a partner of Sir Alexander B. Kennedy, F.R.S., read, in conjunction with Mr. Mordey, a paper on a similar subject (electric traction on railways) in the early part of 1902, to which at the time we referred in these columns.

The paper itself does not contain anything very new, with the exception of some diagrams showing the overhead suspension adopted on the Hamburg Railway, which, unfortunately, were neither explained in the paper nor properly described at the time of the meeting.

The only apparent effect of Mr. Jenkin's paper has been to produce a considerable scare amongst electric telegraph and telephone engineers as to the possible damage which may accrue to their installations, and as to the magnitude of the alterations which they may have to make in consequence of the introduction of the single-phase system for traction purposes.

For our part we believe that, with proper precautions as regards maximum drop in the returns, and by arranging so that the overhead telegraph and telephone wires are entirely removed from the vicinity of the contact line, no serious ill-effects will result in connection with telephone and telegraph installations. We shall look forward with interest to the experience which will be gained when the South London line of the L.B. & S.C. Railway Co. is actually running.

Mr. Jenkin, as one would naturally expect, in comparing the various types of the single-phase motor, tried to show that the ordinary series type, such as is manufactured by his firm, was the most suitable for all purposes. We do not think that the time is yet ripe for any such conclusions to be reached; all we will say is that the single-phase apparatus now manufactured by firms such as Messrs. Siemens-Schuckert, the British Westinghouse Co., the Allgemeine Elektricitäts Gesellschaft, the British Thomson-Houston Co., the Maschinenfabrik Oerlikon Co., and Messrs. Finzi have been adopted on such a scale as clearly to demonstrate the suitability of the single-phase motor of any design for traction work.

Although Mr. Jenkin shows illustrations of the Hamburg overhead line equipment, this line is not mentioned in the list of the single-phase railways in Europe, which is given in the paper.

From the illustrations given of the overhead construction, one would judge that it is of the flimsiest possible character, and that questions of safety and strength have been more or less subordinated to lightness and cheapness. This, however,

is a characteristic which one has often to note in connection with Continental work, and we must reserve any criticism of this installation until such time as it is open for running and has been more fully described.

Mr. Jenkin's paper generally favours single-phase electric traction for railway purposes, and with this conclusion we are inclined to agree; and there are no new developments to cause us to alter the opinions which were first expressed in the leading article of our issue of November 13th, three years ago, in which we advocated the introduction of the single-phase system of traction on our railways.

In this connection the results which will be obtained by the electrification of the South London line of the L.B. and S.C. Railway, which is now being equipped, will not only be watched with the greatest interest by all engineers and railway companies, but will also, we fell assured, result in the general adoption of the single-phase system for perating suburban lines.

Whilst discussing the question of electric traction on railways, we trust that the Government will see its way to create that Traffic Board which was recommended by the Royal Commission on London Traffic, and we are reminded of this by the fact that the conclusions contained in the report of the Royal Commission on Traffic clearly showed the absolute necessity of electrifying the suburban branches of our big railway systems, both round London, and in and around other large cities such as Manchester or Liverpool.

Whilst we note with pleasure that the Midland Railway Co. have decided to try electric traction on a short branch line in the neighbourhood of Lancaster, we greatly regret that they should have relegated such an experiment to a purely branch line, which must necessarily work under totally different conditions to those which would have to be met with in connection with heavy suburban traffic, and we are afraid that any results which they may obtain will not be commensurate with the expenditure they may have incurred.

We trust that the decision to electrify this suburban branch was not arrived at with a view to shelving electric traction by being able to tell shareholders that experiments were being carried out, as was successfully done some years ago by the Metropolitan and District Railways, when, seemingly with the object of postponing general electrification, they, at a great expense, equipped electrically the line between Earl's Court and High Street, Kensington.

Railway companies have been so conservative in the past, and so loth to install electric traction on their suburban systems *in* London, where, of all places in the world, they are most required, that the decision of the Brighton Railway directors to electrify their line between London Bridge and Victoria, which is one of their most crowded suburban branches, becomes the more praiseworthy, and we have little doubt that, if a frequent and rapid electric service is given on the South London line, the results will be such that, in a very short time, all the trains running on the suburban lines of the L.B. & S.C. Railway will be operated by the same means.

The Advent of Gas Tumbler Switch.

While we, doubtless in common with our readers, have often remarked the great improvement which has occurred, of late, in gas fittings designs—an improvement directly and solely traceable to the popularity and convenience of the standard electrical fittings which they are intended to imitate—we confess to a feeling of surprise at seeing a tumbler switch, of orthodox pattern outside, for use with pneumatic gas control installations.

Why our pushful gas friends should go out of their way to disguise a simple pneumatic plunger under the garb of a tumbler switch, we fail to see, unless, indeed, an electrical disguise is a *sine qua non* to progress in the gas world.

That such is actually the case may be surmised from the fact, that not only tumbler switches, but "cotton-covered" pneumatic tubing, and white-wood casing for running the latter from switch to gas lamp, are now being offered to the public.

Only last week we were shown at a local Trades Exhibition a flash sign of approved electrical appearance, but differing somewhat in smell, which we were assured *only* needed perfecting to enable a clean sweep of its electrical predecessors to be made.

We have, ere this, become accustomed to sham arc and Nernst type (gas) lamps, and, in fact, we are looking forward to the day, surely not far distant, when an electrical generator or motor of some kind or other will be a recognised and indispensable accessory of the up-to-date gas installation.

The I.E.E.

Once again, with the approach of Christmas, we find ourselves visitors at Great George Street, enjoying the hospitality of the "Civils" for the coming session; and after the manner of former years, we feel compelled to enter a strong protest against a method of procedure which invariably results in members having to migrate from the admirably adapted Great George Street quarters, towards the end of the session, and further necessitates the holding of extraordinary weekly meetings in make-shift quarters, which are obviously unsuited for the purpose.

After wasting two hours on Thursday evening last week, and watching some hundreds of others do likewise, while Prof. Epstein bravely struggled through his paper on the "Selection and Testing of Materials for Construction of Electric Machinery," we could not help reflecting on the much more businesslike practice of our American cousins, who invariably circulate their papers ahead of—in some cases, months before—the meetings, and justifiably omit the reading of a paper when a valuable discussion can be facilitated thereby. Why cannot some such procedure be followed over here? Even the circulation of brief abstracts of papers before the date of reading, would serve to draw the attention of those interested, who could then obtain complete copies in the usual way.

With matters as at present, one may justly assume from a crowded house, that interest has been aroused in a paper; further, a proportion of those interested undoubtedly attend with a view to discussing the paper—which they can obtain if they apply for it and study prior to the meeting. Obviously, the reading of the paper in detail is time wasted to such people, and it must be noted that *they* are the people who sustain the interest in a subject, who interest others in it, and who enhance generally the value of the proceedings; and, furthermore, they may not be present on a second evening. Clearly, what is wanted is a strictly limited abstract of the paper, which an author might, if he desired, supplement orally during the first half-hour of the meeting, and which would be followed by discussion.

Only in this way, if the usual number of papers are accepted, can the business of the session be kept well in hand, and some such arrangement is emphatically a necessity to any business man.

The Supply of Electricity Bill.

The recently published text of the Government Bill relating to electricity supply will be perused with pleasure by those who have long recognised the cumbersome, expensive and unbusinesslike procedure frequently entailed under the present arrangement. The aim of the Bill is to do away with special legislation and to vest in the Board of Trade powers now reserved to Parliament.

That the initial operations of supplying what has come to be recognised as a necessity of modern times should be so hedged round with restrictions and expense, must surprise anyone approaching the matter from a purely business standpoint; that it has remained until the present year of grace for the subject to receive common-sense treatment is equally astonishing.

However, the 17 clauses of the present measure, although a somewhat tardy concession, are a step in the right direction, calculated to facilitate the extension of electrical supply work.

Among the clauses, the first enables the Board to authorise by provisional order an undertaker to acquire compulsorily, land specified for a generating station, whether situated within or without the area of supply.

Clause 3 offers a most important advance on present procedure. It runs as follows :—

3. The Board of Trade, unless they are of opinion that by reason of the character or magnitude of the proposed undertaking, the matter ought to be dealt with by Private Bill, may by Provisional Order—

(*a*) Authorise any company or person to supply electricity in bulk to any local authority, company, or person authorised to supply electricity in any area for the purpose of distribution by that local authority, company or person within that area; and

(*b*) Provide for any supply so authorised being compulsory; and

(*c*) Authorise any local authority to supply electricity in bulk to any other local authority; and

(*d*) Define what are to be the limits of supply for the purpose of the provisions of the Gasworks Clauses Act, 1847, incorporated in the Electric Lighting Act, 1882, in the case of a local authority, company or person so supplying electricity in bulk; and

(*e*) Make such other provisions as appear to them necessary for adapting the Electric Lighting Acts to any case where a local authority, company, or person are authorised to supply electricity in bulk.

Provision is also made for the supply by an authorised undertaker of energy for traction haulage and lighting on any railway or tramway situated partly within and partly without the undertaker's area of supply; and further, for the joint exercise of powers by two or more supply authorities in an area.

Clause 8 substitutes five years for the seven years' period of revision of maximum prices, and other clauses relate to the certification of meters, and the construction of the prohibition of association clause in the Electric Lighting Act, 1899, which shall not prevent the exercise of supply-in-bulk powers.

On the whole we must be thankful for the small mercies outlined above, they indicate an unlooked-for reasonableness on the part of the powers that be. We trust the Bill will speedily become law.

The Electrical Industry.

Amid the November shower of inaugural addresses to engineering societies and their offshoots, there stands out one to which we wish to draw the special attention of our readers. It is that of Dr. C. V. Drysdale, delivered before the London Students' Section of the I.E.E. on the 14th inst. We regret that we cannot reproduce it in full; but elsewhere in this issue we give an abstract in which we have endeavoured to include the leading ideas of the address, and we hope that the Council of the Institution will see fit to print the address *in extenso* in the *Journal*.

The Engineer.

Whether engineers are the salt of the earth or not (we have no doubt they are, though the question is fairly arguable) a very pretty essayist was spoiled when Sir Alexander Kennedy became an engineer. Essay writing, at least of the lighter kind, is a very curious and rare gift. Many thousands of these compositions are produced yearly as formal essays, sermons, newspaper and magazine articles, papers and addresses. Most of them would be entertaining if their writers knew how to make them so, but to how few does one return for the mere pleasure of re-reading! Andrew Lang and Augustine Birrell at their best may possibly stand with Elia and de Quincey and Thackeray and Wendell Holmes, and though one may add a name or two, the list is woefully short. Much of Sir Alexander's presidential address to the Civil Engineers has the nice touch and irony which are the essence of this kind of composition. We do not suggest that the address is a finished essay; that is not its *raison d'être;* but we cannot help reflecting that while good engineers are many, many too many, good essayists are few; and that the essays of Elia may be read when the electric tramways of the London County Council have gone to their long home, and only electric motor-'buses go about the street. Perhaps the design of Providence in making Sir Alexander an engineer was to furnish his mind with subjects suitable for essays. If that is so we shall shortly see his practice abandoned for the pursuit of literature, unless by ill luck the *Times* Book Club should decide to suppress literature in the interest of books, of which notice may be looked for almost any morning. Other eminent professional men have published volumes of essays or reminiscences, the occupation of their leisure or retirement, and in many cases most felicitously. Sir Edward Fry's essays, we recall one in particular on the delights of being a conveyancer, are a case in point. Why on the publication of that essay young England to a man did not enter into the profession of conveyancing has not been explained. Perhaps it did, and we have not heard of it. Sir Archibald Geikie's literary gifts enable him to persuade anyone that there is no career in life worth consideration other than the study of the glaciation of the Scotch Highlands, or the river systems of England. We should like to see Sir Alexander Kennedy do the same for engineering. His address, however, tends rather in the other direction, that engineering as a mode of life is neither better nor worse than any other mode.

That the complete engineer should be an artist, a man of letters, a lawyer, a man of the world, a philosopher, and a gentleman is the main thesis of the paper. Fortunately he is not expected to be a prophet, and is even discouraged from the practice of prophecy.

The discussion of his relation to the beautiful is very happy, and as it is a subject on which everyone is equally qualified to form an opinion, and does, as a matter of fact, form one, is of general interest. This part of the address, though it touches the subject lightly and briefly, says almost everything there is to be said, and is convincing and satisfactory from its sweet reasonableness, just as Ruskin's arbitrary dogmatism on the same subject excites one's antagonism. Ultimately the question of beauty is largely one of orderly propriety; and one's judgment of beauty depends upon appreciation of the purpose to be served and his ideas of the best method of attaining it. With the use of ornament the engineer has nothing to do, and is not to be trusted. It is too much a matter of the habit of the eye, and should be left to the professional artist. A conscientious attempt to harmonise arc lamps with Gothic buildings by hanging them on columns of curly Munich ironwork made the gods weep. The locomotive section at the last Paris Exhibition was another case in point. The South-Western and Midland engines shown there were beautiful specimens and exquisitely finished, but their appearance was universally condemned by foreign engineers, to whose eyes the coloured paint of the boiler casings, and the quantity of bright finished work was wholly inappropriate and offensive. To our eyes the large Russian engines looked slovenly and ill-proportioned, and in consequence irredeemably ugly. The difference was really one of habit and idea, and had no relation to any principle of ornament or beauty.

We cordially agree with the President that on the whole engineers have not injured the country but have greatly beautified it. A railway and a station in the gorge of Symond's Yat, the great wheel at Earl's Court, and the Blackpool Tower, are, of course, deplorable; but the crawling line of steam from a distant locomotive, a group of white lighthouse buildings on an isolated rock, ships passing under a great promontary, a lofty viaduct across a wooded valley, or a massive dam with a sheet of water behind it, add very much to the interest and charm of a view. And we condemn the instances above on precisely the same ground as Sir Alexander condemns the Jungfrau Railway. The essential vulgarity is of the purpose to be served, not of the actual object that we see.

The quality of orderliness, of clear purpose directed to a worthy object, is characteristic of all admirable things, in literature and conduct, as well as in art and engineering. It is this quality which is desiderated in drawing specifications, in designing structure or machinery, in scientific research, and in the construction of a Presidential address.

THE ELECTRICAL EQUIPMENT OF A NEWCASTLE RAILWAY WAREHOUSE.

THE North-Eastern Railway Co. brought into use during October a new goods station and warehouse at New Bridge Street, Newcastle-on-Tyne, to replace the Trafalgar goods station and to provide adequately for the rapidly-increasing traffic requirements of the large and important commercial and industrial district of which Newcastle is the metropolis. The new structure, which is built throughout on the Hennebique patent ferro-concrete system, and the principal dimensions of which are 430 ft. in length, 180 ft. wide and 84 ft. in height, from the floor of the basement to the head of the parapet, has been fully described in various technical journals, its remarkable character as the most impressive example of this method of construction adapted to railway requirements having attracted considerable attention. Its equipment, however, is scarcely less noteworthy than its structural features, and deserves the notice which we are enabled to give, thanks to the courtesy of the mechanical engineer's department of the N.E.R.

The machinery in and about the warehouse is of the most modern electric type, and constitutes a great advance upon the equipment of any other similar building that we have seen. Throughout it has been designed and arranged for the rapid handling of goods with a minimum expenditure of manual labour and time. Energy is obtained from the mains of the Newcastle Electric Supply Co. in the form of continuous current at a pressure of 480 volts, and is controlled from a central switchboard in the warehouse, from which the energy is distributed to the various machines and lighting circuits.

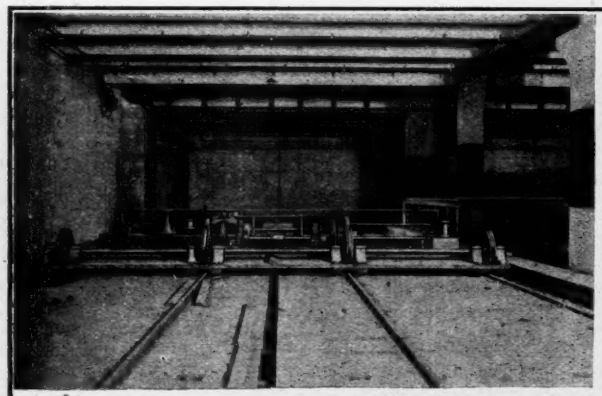
The electrically-driven machinery comprises 10 cranes, two transporters, six jiggers, two wagon hoists, one wagon traverser, and 42 capstans—63 machines in all. The motors, which total 95, are of the series-wound enclosed multipolar type, with the exception of those in the capstans, which are compound wound so as to enable them to deal with a variable load with slight variation of speed. The machine motors are protected by means of magnetic blow-outs as well as fuses, and in the case of machines where two motors are required, "universal" controllers are employed. The cages of the cranes for accommodating the drivers are provided with switchboards and fuses, while bunch lamps are fixed on the revolving jibs to enable the operator to see his work clearly.

The gearing of the machinery throughout has machine-cut teeth, and where possible the bearings are fitted with Stauffer's "tell-tale" lubricators, which show at a glance the quantity of lubricant in the lubricator, and require only a minimum of attention.

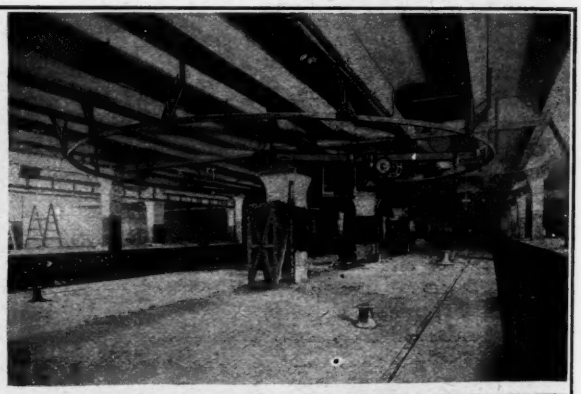
The *modus operandi* of handling the goods is as follows :—

In the case of the basement, which is a low-level goods station, wagons are drawn by means of capstans into either of the two wagon hoists at the ground level and lowered 16 ft. to the rail level of the basement, where they are drawn off the hoist table on to a wagon traverser which cross

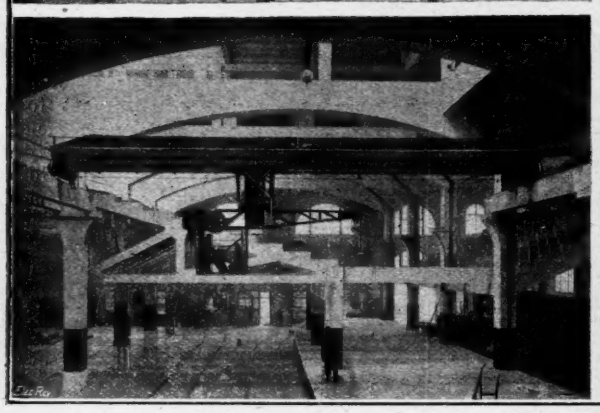
BASEMENT: 30-TON ELECTRIC TRAVERSER FOR WAGONS.



BASEMENT: 1-TON RADIAL PILLAR CRANE.



GROUND FLOOR: 1-TON ELECTRIC TRAVELLER.

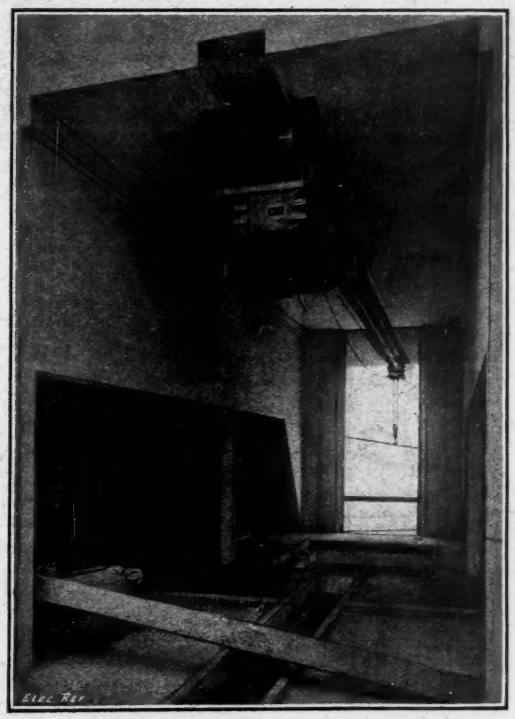


SECOND FLOOR: 1-TON ELECTRICAL TRANSPORTER.

traverses the basement warehouse and sets the wagon opposite any of four roads as required. The wagons can then be moved by means of the 16 capstans and four turntables with which the basement is equipped, to any desired position, while two pillar cranes with a radius of 19 ft., lift in and out of the wagons and lorries placed within their radius, and two travelling cranes fitted with revolving jibs of 12 ft. radius, deal with the wagons and lorries placed near them as well as the platform over which they travel. The main feature of these cranes is that although they only span the platform, some 20 ft. wide, they can reach the wagons and lorries placed beside it by cross traversing the crab with the revolving jib extended towards their object, and so command an area of nearly 40 ft. in width by 200 ft. in length.

The ground floor, which is a high-level station, has six rail tracks running into it, fed by 16 capstans and eight turntables inside the building, and ten capstans and four turntables outside. The four travelling cranes on this floor are provided with revolving jibs, similar to those in the basement, except that the span in this case is 48 ft. 6 in., and by a similar arrangement commands a much larger area

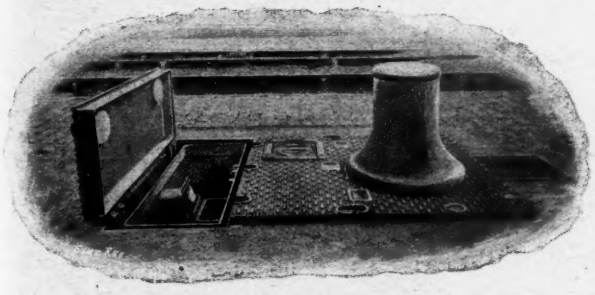
than is represented by their span. The jib radius is 11 ft., and the length of track 300 ft. The two wall cranes, each with a 17-ft. radius of jib, both deal with the one road—that



THIRD FLOOR; 15-CWT. ELECTRIC JIGGER.

next the east wall of the warehouse, and lorries placed within their radius.

The two transporters, or conveyors, on the second floor work right across the building under the skylights, some 70 ft. above the ground floor rail level, on a track which projects beyond the walls of the warehouse 16 ft. on each side, carried by ferro-concrete cantilevers of novel design. By this arrangement they can pick up a load from any of these six ground floor roads or from the two outside roads nearest the east and west walls of the warehouse respectively, and can place it on either of the floors above by working through suitable hatchways. The six jiggers which can pick up from or lower on to the roads next the walls outside, serve the first and second floors, while two of them also



GOODS YARD; 1-TON ELECTRIC CAPSTAN.

serve short lengths of the third floor, adjacent to the automatic flour and grain storage chute at the south end. These jiggers have a travel inside the warehouse of 20 ft., and are each worked by one set of controllers placed near the hatchways, which can be operated from any one of the floors. An ingenious mechanical interlocking device prevents conflicting movements, such as would occur in the case of two men trying to operate at the same time from different floors. Overwinding, overhauling and other probable derangements are carefully provided against, and the capstans are fitted with Napier brakes to prevent the head running back—a fruitful cause of accident in the hasty hauling of wagons. Altogether the installation is admirably complete and compact, combining lightness and ease of movement with great capacity and power, and affording exceptional facilities for dealing expeditiously with traffic. The machinery of the warehouse has been supplied by Messrs. Craven Brothers, of Manchester, and the electrical equipment by Messrs. Siemens Brothers. The turntables were made by Messrs. Cowans, Sheldon & Co., of Carlisle. We append a summary of the capacity, speed and power of the machinery.

Machine.	Operation or movement.	Capacity. Tons.	cwt.	Crane speed, F.P.M.	Motor B.H.P.	Motor speed, R.P.M.
Basement.—Two overhead cranes (revolving jibs and travelling cage), track length, 200 ft.	Travelling,	0	20	200	2¼	500
	cross-trav.,	0	20	100	1½	500
	revolving,	0	20	150	1½	500
	hoisting.	0	20	60	6	500
Two pillar cranes, radial type, with travelling cage.	Revolving,	0	20	150	1½	500
	hoisting.	0	20	60	6	500
Two wagon hoists, with balanced cage; length of wagon, 25 ft.	Raising,	20	0	60	2×50	500
	lowering.	30	0	60		
One wagon traverser, with capstan attached.	Traversing	—		300	26	500
	c'pst'n pull	—		200		
16 capstans	Pulling.	0	20	250	26	340
Ground Floor (outside building).—10 capstans.	Pulling.	0	20	250	26	340
Ground Floor (inside building). — Four overhead travelling cranes, revolving jibs and travelling cage; track length, 300 ft.	Travelling,	0	20	350	5	500
	cross-traversing,	0	20	150	1½	500
	revolving,	0	20	250	1½	500
	hoisting.	0	20	150	15	500
Two radial wall cranes, with separate operators' platform.	Slewing,	0	20	150	1½	500
	hoisting.	0	20	60	6	500
16 capstans	Pulling.	0	20	250	26	340
Second Floor.—Two conveyors or transporters, with travelling cage.	Travelling,	0	20	350	1½	500
	hoisting.	0	20	150	15	500
Four jiggers, working through two floors.	Travelling,	0	15	120	1½	500
	hoisting.	0	15	100	10	500
Third Floor.—Two jiggers, working through three floors.	Travelling,	0	15	120	1½	500
	hoisting.	0	15	100	10	500

PROCEEDINGS OF INSTITUTIONS.

High-Speed Electric Machinery: With Special Reference to Steam Turbine Machines.

By Prof. SILVANUS P. THOMPSON, D.Sc., F.R.S.

(Abstract of Howard Lectures delivered before the SOCIETY OF ARTS, *January 18th and 25th, and February 1st, 1906, and published in the Journal of the Society.)*

(*Concluded from page* 820.)

STRUCTURAL DETAILS.

WE pass on to the modifications which are brought into the revolving field-magnet by the necessity laid upon the designer of obviating all risk of change in the balancing, and all chance of accidents from excessive centrifugal forces. In the older type the individual pole cores were masses of either assembled stampings of laminated mild steel or else blocks of cast steel, secured to the rim of the fly-wheel structure which served as foundation. But, in view of the enormous centrifugal forces in turbo-alternators, poles, foundation wheel and shaft are all merged into one structure. The magnet-wheel has become a solid rotor, with magnetising windings embedded in its mass, and is scarcely recognisable at first as a field-magnet.

PARSONS TURBO-ALTERNATORS.

Such changes do not come about all at once; they are the result of development. In the early forms of Parsons alternators of some 14 years ago, the bipolar field-magnets were fixed and external, the armature revolving within. Eight or nine years later the alternator had become a four-pole machine of larger size, and the copper conductors on the revolving armature were carried through tunnel slots under the periphery of the core disks. But these constructions have been found inadequate, and, at the present time, all the makers of turbo-alternators design them with the armature fixed and external, and the field-magnet internal and revolving. In Parsons's recent alternators the field-magnet is a solid block of

steel of cruciform section. Upon each arm of the cross is carried an exciting coil of copper strip. This is secured from flying out radially by the application of heavy pole shoes, which are dovetailed along the whole length of the pole, and the coils are further secured in place by bronze corner-pieces bolted down into the inner body of the magnet. The shaft is in two parts, pressed into the ends of the solid rotor body by hydraulic pressure. The polar surfaces are not concentric with the armature face, but are shaped off so as to secure a better distribution of the flux. Further, the polar surface is itself divided by a number of cuts turned round it at regular intervals, leaving a number of projecting ridges which become more highly saturated than the rest of the core, thus tending to avoid distortion of the flux. The stationary armature, built up of assembled laminations, is provided with numerous ventilating ducts that are kept open by the insertion of spacing pieces. Air drawn into the interior finds its way through these

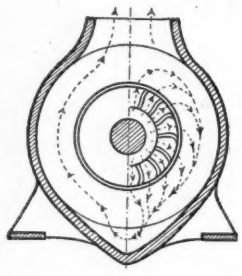


Fig. 13.—Ventilation Scheme. (Brown, Boveri & Co.)

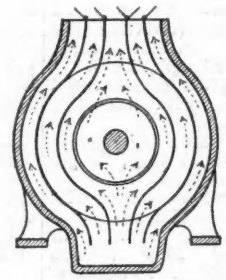


Fig. 14.—Ventilation Scheme. (Oerlikon Co)

ventilating ducts, and so keeps the windings cool. The stator core rings are mounted within the housing in such a way as to leave a surrounding hollow chamber within the external shell. At the top the shell has an opening resembling a short chimney; so that the air which passes into the chamber rises out at the top, and ventilates by a natural draught. The interior hollow space is arranged with baffles to guide the flow of air, so that every part is properly ventilated.

The large Parsons alternators at Carville, Newcastle, are four-pole machines of 5,000 kw., and work at 1,200 r.p.m. The turbines are of 8,000 h.p.

Other Constructors.

On the Continent, the principal licensee of Mr. Parsons is the firm of Brown, Boveri & Co., of Baden, Switzerland. Mr. C. E. L. Brown took up the design of the turbo-alternator at the point where it had been found impracticable to use revolving armatures; and the development of the type with revolving field-magnets is largely due to him. In the special type of revolving field-magnet created by Brown, Boveri & Co., the body of the magnet is a solid cylinder of steel, with two projecting hubs at the ends, into which the shafts are squeezed by hydraulic pressure. Eight circular ducts, about 1 in. wide, are turned in the steel face; also longitudinal slots, with overhanging tips, are ploughed along the core to receive the windings, and the slots when so filled are closed by the insertion of wedges. Over the end bends bronze caps are fitted, these caps being furnished with blade-like structures, which promote the ventilation by fanning. The exciting current is introduced through a single steel slip-ring at each end. The surface of the revolving part presents, therefore, an almost unbroken periphery—a form that is preferred because it is less noisy than those which have salient poles. Pockets are provided, both in the steel core and in the bronze caps, for the insertion of lead masses for balancing; for it is found expedient to balance the core before it is wound, and again after the winding is completed.

Figs. 11 and 12 (pp. 818-9) depict a three-phase Brown turbo-alternator of 1,000 kw. at 1,500 r.p.m., designed to give three currents of 289 amperes at 2,000 volts between the lines. The peripheral speed at the rotor face is 12,600 ft. per minute, the diameter being 33·4 in., and the core length 25·5 in. The mean value of the flux density over the pole face is 32,500 lines per sq. in. The stator core disks have 48 slots, with four conductors per slot. The rotor has four poles, with six large slots between each pole and its neighbours, the magnetising winding around any pole being inserted in three slots on each side of that pole. It is evident, therefore, that each pole, considered by itself, consists of a middle solid part which has a maximum number of exciting coils surrounding it, and of neighbouring parts which are surrounded by a smaller number of exciting turns. This arrangement leads to a distribution of magnetic flux approximating roughly to a sine distribution.

Attention is directed to the ventilating arrangements of this alternator. The housing of the stator is extended at the ends to form two chambers covering the projecting hubs. Into these two chambers air is admitted from below, as shown by the arrows. This air is caught by the fans on the bronze caps of the rotor, and driven past the end bends of the stator winding into the shell of the housing, then up through the air ducts between the laminations, and finally out of the chimney at the top.

The stator winding of a turbo-alternator may be carried out in various different ways. The particular way adopted in the Brown-Boveri machine, fig. 12, is not usual, nor is it characteristic of the latest machines of that firm. As will be seen from the sketch, the conductors are in two layers in the slots, and the end bends are united in a manner resembling the barrel winding of a continuous-current drum armature, the winding being a wave winding which, in the present instance, is interrupted at three points, so as to furnish the three phases. This type of construction is good so far as the ready ventilation of the end bends is concerned, but it is not desirable so far as relates to their mechanical support.

Another type of stator winding is that so common in alternators of the older species, in which the end bends project out in two or three ranges. Here, again, there is a necessity for brackets to anchor the projecting ends, because of the enormous mechanical forces which come upon the conductors, particularly in the event of a short circuit.

A third type of stator winding is that in which each "coil" has a long and a short side, and the end bends or connectors all spiral over equal chords, helical twists that lie in the same direction. This kind is sometimes known as "basket winding," because of its outward resemblance to imbricated wicker-work. The end bends support one another very compactly. There is less self-induction than with those types where the end bends project further into space.

Ventilation has been referred to as a prime consideration in turbo-alternators. In no other piece of electric apparatus is so much power concentrated in so small a volume. For example, in the four-pole Brown machine, figs. 11 and 12, 1,340 h.p. are converted into electric power in a stator containing about 4,300 cb. in. of copper and steel. If, by reason of a short-circuit, this amount of power could be concentrated on the metal of the stator, the energy developed as heat would suffice to raise the whole mass to a red heat within 3 minutes. If only 1 per cent. of the energy were wasted on heating the copper and iron, the external surface would be quite inadequate to get rid of the heat unless the temperature rose far above the permissible limits. Hence the necessity of numerous ducts and of contrivances for ensuring that the air shall circulate through them. If the mere peripheral surface is reckoned out, it may be taken that, with the high peripheral speeds of 10,000 to 16,000 ft. per min., each square inch can get rid of one-sixth to one-tenth of a watt for a temperature rise of 1° C. Or, if a temperature rise of 35° C. is permitted, the armature can get rid of from 6 to 3½ watts for each inch of its peripheral surface.

The methods that have been proposed for bringing about an effective circulation of air may be further illustrated by the two diagrams of figs. 13 and 14. The first of these is due to M. Aichele, of Brown, Boveri & Co., in which fans at the ends of the rotor draw in air and send it first downward and then upward through successive quarters of the machine. Fig. 14 illustrates a method devised by the Oerlikon Co. Here the ventilating ducts are divided by baffles which go from top to bottom, thereby causing the air to traverse definite passages ending in ventilating openings at the top. Over these various openings there are lids which can be raised or lowered if it is found that any one part of the machine requires to be more thoroughly ventilated than another.

Other makers adopt different plans. In the machines of Dick, Kerr & Co., and in some of those of the Westinghouse Co., the stator housing is made with large apertures perforated at intervals all over to secure free access of air, with no attempt at internal

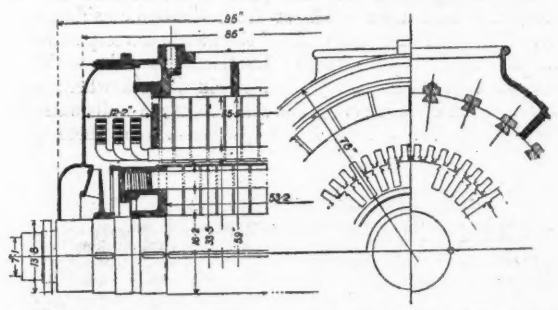


Fig. 15.—Three-Phase Turbo-Alternator, ATB2—1,500—1,500. (Oerlikon Co.)

baffles. The Allgemeine Co. has essayed another plan, bolting together between strong end shields the stator core rings, but entirely omitting any external housing, and thus securing the most complete access of air to the stator iron.

The British Thomson-Houston Co., following the initiative of the General Electric Co., of Schenectady, has adopted the vertical pattern of Curtis turbine, and manufactures turbo-alternators up to 5,000 kw. The revolving field-magnets of these machines have definite salient poles. The ventilating arrangements are peculiar. Between the poles are bronze corner-pieces to clamp the windings; these are provided on their outer surfaces with projecting ridges which are not concentric, but which are disposed skew-wise, so that they act like the blades of a windmill. When in revolution these blades draw in air and propel it downwards through the turbine. The downward direction is chosen because, as the alternator is mounted on the top of the turbine, it is very important to prevent hot air or stray steam from a leaky gland from rising and getting access to the insulation of the windings.

Fig. 15 illustrates the design of a two-pole, 1,500-kw., 50-cycle Oerlikon alternator (three-phase) revolving at 1,500 r.p.m. The stator bore is 34 in. in diameter, and the gross core-length 56 in. The stator has 48 slots, with two conductors per slot. The rotor has 36 slots, with 46 conductors per slot.

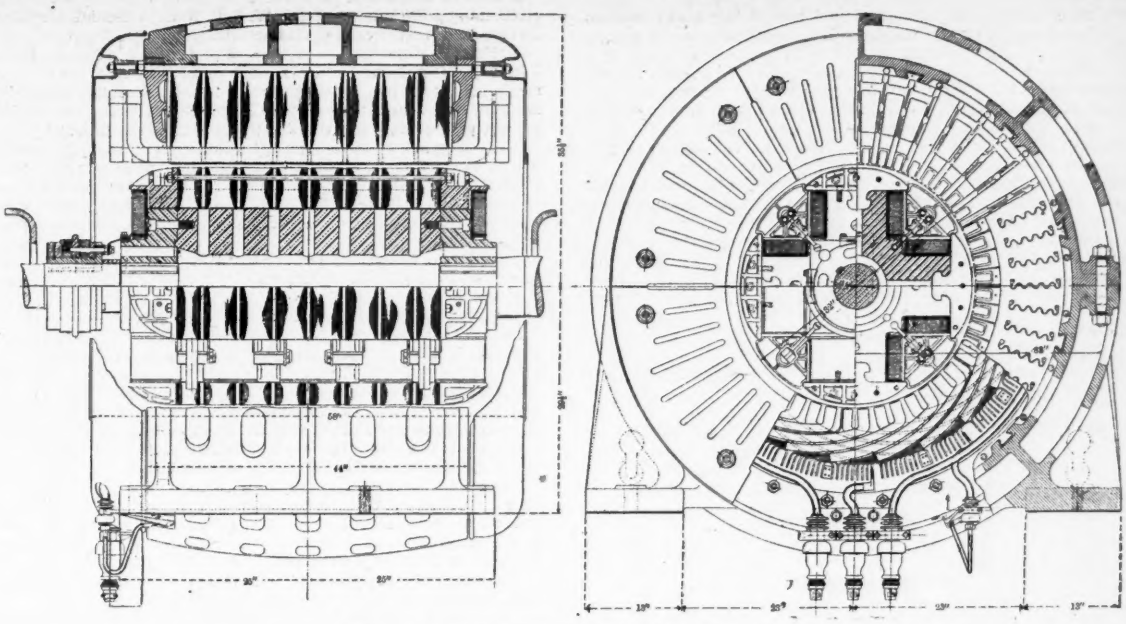


Fig. 16.—Turbo-Alternator. (Dick, Kerr & Co.)

We may compare with the four-pole Brown machine, another four-pole 1,000-kw. alternator supplied to the Bristol Corporation by Messrs. Dick, Kerr & Co. The comparison supplies several contrasts. The Preston firm uses in this machine (fig. 16) the basket winding in preference to the in-and-out winding in two or three ranges. They have the coil-ends bent spirally round.

A larger machine of Dick, Kerr & Co. of 3,000 kw., 750 r.p.m., has been supplied to the Corporation of Glasgow. In this case there is a three-range winding, with the end-bends strongly bound together. Brackets are employed to prevent the coils from shifting. There is no attempt to insert baffles or provide flues, but there is a very thorough ventilation by holes through the housing, and by ducts in the interior through the coils. The whole of the pole-structure is laminated at the tips, and there are ducts for ventilating all along through the revolving poles.

Specific Utilisation.

In my first lecture I pointed out the factors of specific utilisation and dwelt upon them, and how we can make the best use of the cubic inch of material in the active belt. There are the three factors—the gross current density, the gross magnetic density, and the peripheral speed (in this case the figures of the table below are in inches per second); the product of the three, divided by 10^7, giving the number of watts per cubic inch of active belt. For the old style of alternator I have taken a number of typical machines. Taking the machines of the old-fashioned, slow-speed type, the number of watts per cubic inch lies between 57 and 81; but the turbo-alternators, with their higher surface speeds, give higher values ranging from 117 to 288, with an average value of 175. The figures of specific utilisation amply show that for a given quantity of iron and copper a very considerably higher duty is attained by adopting high-speed driving.

Whether the old-fashioned engineers like them or not, it is perfectly clear that turbines are being adopted wholesale, and that they are replacing other types. They have proved themselves quite equal to, and some people say better than, large compound condensing reciprocating engines. You gain in the small number of moving parts, in the simplicity of lubrication, and lose in that the moving parts go so quick that you cannot be sure what is happening to them. The moving parts are not so accessible as those of the low-speed machine; but then there is no need of access for months together. This is a purely steam engineers' question into which I do not dare to enter. I have tried to avoid all criticisms upon the steam-engine part of the problem, and to deal only with the problems which relate to the electrical design and construction.

I cannot conclude without saying how much I have been impressed, in arranging the matter for these lectures, with the extreme sagacity, as well as the genius and tenacity of purpose, of Mr. Parsons in fighting his way not only through the steam problems of the turbine, but also through the electrical problems, and I feel that I have not been able to do adequate justice to his many and great achievements. All honour to the pioneers.

Finally, I have to acknowledge gratefully the co-operation of a large number of firms, and to record with gratitude the services of my assistant, Mr. H. W. Taylor, in lightening my labour in various ways.

Utilisation Coefficients of Slow-Speed and High-Speed Alternators.

		α'	β'	γ'	Watts per cb. in.
Slow-Speed Alternators.					
Oerlikon	ATB 72 — 1,500 — 83	208	36,000	1,023	71·8
Heyland	ATB 64 — 760 — 94	236	26,000	1,160	71·2
Oerlikon	ATB 10 — 290 — 600	286	27,400	1,030	81
Brown	ATB 28 — 1,640 — 180	153	25,500	1,524	59
Kolben.....	AQB 96 — 3,500 — 75	208	24,600	1,180	57·1
Westinghouse	AQA 62 — 1,500 — 116	261	25,500	1,214	81
Turbo-Alternators.					
Parsons.....	ATB 4 — 3,500 —1,200	300	23,700	2,625	188
Westinghouse	ATB 4 — 1,800 —1,500	271·5	26,000	3,020	212
Brown	ATB 4 — 1,000 —1,500	420	25,500	2,620	288
B.T.-H. Co. ...	ATB 6 — 1,880 —1,000	199	30,800	2,480	168
B.T.-H. Co. ...	ATB 6 — 1,500 —1,500	186	31,300	3,760	157
Dick, Kerr ...	ATB 4 — 1,000 —1,500	144	29,100	2,560	127
Dick, Kerr ...	ATB 4 — 3,000 — 750	113	52,000	2,040	122
Dick, Kerr ...	AQB 6 — 3,000 —1,200	255	33,000	2,582	212
Oerlikon	ATB 2 — 1,500 —1,500	200	11,000	2,740	117

Institution of Electrical Engineers.

Manchester Section.

The opening meeting of the session was held in the Midland Hotel, Manchester, on Tuesday, November 20th, when Mr. T. L. Miller delivered his address as chairman of the section.

Mr. Miller remarked that in addition to technical training, a student should undergo shop training to make him familiar with the operation of machine tools and appliances under actual conditions on a commercial scale, and to teach him how labour must be organised to produce the best results at the lowest costs.

The commercial instinct was essential to success, and the young engineer must have a good working knowledge of estimating and the analysis of accounts, together with an acquaintance with business and commercial law and finance. The man responsible for a design should be enabled to follow the work in the shops, and to check the cost of every step in the process of manufacture. The same argument was applicable to all branches of the profession.

Some years ago the Institution of Civil Engineers decided that candidates for admission to the roll of membership should satisfy the Council regarding their knowledge of the general principles of science, and should qualify in the particular branch of engineering to which they proposed to devote themselves, and Mr. Miller thought that before many years the Council of the Institution of Electrical Engineers would adopt a similar course. He laid stress on the duty of members to support the Institution by attending its meetings and taking part in discussions.

Mr. Miller next sketched the history of the Engineering Standards Committee and its sub committees, giving particulars of the reports already issued in connection with electrical matters, and urged the members to conform, as far as possible, with their findings.

Dealing with the question of electricity supply, he observed that the most serious problem at the present day was the reduction of the price of electrical energy; further economies in the cost of generation and distribution could hardly be looked for, and it was only from an increase in the volume of business, resulting in a better utilisation of the plant, that improvement could be expected. Referring to the various methods now adopted for the development of new business, he pointed out the increasing importance of the

commercial side of electricity supply. With regard to the vexed question of depreciation on municipal undertakings, there was no statutory obligation to provide for this, in addition to the sinking fund; but a reserve fund amounting to 10 per cent. of the capital might be provided, and could be raised to the said limit whenever, by demands upon it, it fell below that value. Further, the net surplus in any year could be applied in reduction of capital borrowed. The principles officially adhered to by the L.G.B. were (1) That the loan period should not exceed the life of the works; and (2) that the future ratepayers should not be unduly burdened. Although 25 years had been adopted by the L.G.B. as the equated life of the buildings, machinery, mains, &c., it was morally certain that some of the plant would require renewing before the end of that period, whereas other portions would probably last longer. In the case of a company it was necessary to provide a depreciation fund sufficient to renew the assets at the end of their useful life without raising fresh capital; but a local authority was obliged to extinguish the whole cost of the plant in a fixed period, and the depreciation fund was required only in respect of items that would require renewal within that time.

The periods allowed by the L.G.B. for repayment of loans for extensions were as follows:—

Cables—Laid in ducts or on the solid system ...	25 years
Armoured cables laid direct in the ground	15 ,,
Switchboard and switches	25 ,,
Dynamos	20 ,,
Wiring inside buildings	20 ,,
Steam engines	15 ,,
Transformers	15 ,,
Motor transformers, boosters, balancing sets, rotary converters	15 ,,
Instruments	15 ,,
Motors for hire or in generating stations ...	10 ,,
Others in shops belonging to the Council ...	15 ,,
Lamp pillars and brackets for public lighting ...	10 ,,
Batteries and accumulators	5-7 ,,
Meters and indicators	5 ,,
Arc lamps (*i.e.*, lamps themselves)	5 ,,

(Nernst and incandescent lamps and carbons for arc lamps—no loan allowed.)

It would be seen, therefore, that the proper amount to set aside for depreciation depended upon the type of plant concerned, and the care taken in maintaining it, each case being considered on its merits.

There was an extraordinary divergence in the methods of assessment for rating purposes adopted by different authorities, but lately the tendency had been to adopt the "hypothetical tenant" principle, based upon the receipts and expenditure. There were, however, many difficult questions to be settled in arriving at the rateable value, owing to the necessity of estimating the tenant's working capital and of the statutable deductions, and the principle was hardly applicable to the early years of electricity undertakings, where the receipts were not sufficient to cover all expenses and to leave a margin of profit, for in spite of the absence of profit there was a true rental value.

Referring to a recent decision of the L.G.B. with regard to the charging of the wages of permanent employés to revenue, although engaged in carrying out work chargeable to the capital account, especially in connection with Bristol and Grimsby, Mr. Miller said that the effect of the decision would be severely felt by small undertakings, where the staff might be usefully employed in laying services and carrying out extensions. Such work was properly a capital charge, and by discharging the permanent men and then contracting with them to do the work, the objection of the Board could be overcome, so that it was difficult to see the reason for the Board's action.

It would appear that considerable time might be saved if all electrical matters, not only tramway matters as at present, could be referred to the Board of Trade, who, before sanctioning a loan, could ascertain from the L.G.B. the extent to which the borrowing powers of the applicant had been exercised.

Mr. M. B. Field, in proposing a vote of thanks to the chairman, said the Manchester Section had a very high reputation, and he thought that during the last session—thanks to the retiring chairman, Mr. S. L. Pearce—the Section had improved both in efficiency and in dignity.

Dr. Bowman seconded the vote of thanks, which Mr. T. L. Miller acknowledged.

A smoking concert was held after the address, at which a presentation was made to Messrs. E. W. Cowan and P. A. Ramage (late honorary secretaries). Dr. Hopkinson, in making the presentation, said that whatever success the Section had enjoyed was chiefly due to the two hon. secretaries, first Mr. Cowan and afterwards Mr. Ramage. He was sorry Mr. Ramage alone was present, Mr. Cowan having sailed a few days previous to the meeting to South Africa, carrying with him his present, which consisted of a pair of binoculars and an aneroid barometer. Mr. Ramage's presentation consisted of a dressing case. Mr. Ramage expressed his thanks to the members, and a letter from Mr. Cowan to the same effect was read.

Dublin Local Section.

The opening meeting of the Session was held on Thursday, November 22nd, Mr. T. Tomlinson in the chair.

A vote of thanks was passed to Mr. P. S. Sheardown, the retiring chairman, on the motion of Mr. W. J. V. Sowter, seconded by Prof. Thrift, for his services as chairman during the past year.

Mr. A. W. Whieldon, chairman-elect, then took the chair and delivered his inaugural address. He said that his remarks would apply chiefly to the electrical work of the Gt. Northern Railway of Ireland, which had very largely adopted electricity, and in that respect undoubtedly led the way among the Irish railways. Irish railway companies had not the capital outlay or the large incomes which the great English companies had, and were therefore unable to adopt the refinements which the large and important companies in England had at command. Still, his company had a very large system of telephones, electric signals and telegraph lines, lighting plants and the electric railway from Sutton to Howth.

In order to keep capital expenditure at a minimum his department had been obliged to take up the design and simplification of a considerable portion of the electric signalling appliances. Mr. Whieldon described in detail a contact he had devised, which was fixed to the railway metals in such a manner that the vibration of the metals, when a train was approaching, was sufficient to enable the mercury contained in a cup with a rounded bottom to make contact and so to give warning of the approach of trains at the gates of level crossings. The cup was specially arranged with a rounded bottom internally, as in the first experiments a flat bottom had been used, but it was found that with that arrangement any alteration in the angle due to platelayers packing up the rails caused the contact to be made permanently; the rounded cup obviated this difficulty. The apparatus had been in use over three months, and had signalled the approach of 15,000 trains without a single failure; moreover, the apparatus could be made and fixed for about five shillings, whereas another apparatus which they had in use for the same purpose cost as many pounds. This was an important matter where hundreds of these appliances were required.

Most of the railway systems in Ireland were worked on a single line, and the staff method of signalling was employed. Although men became very expert in handing in and delivering the staffs on the various sections, being able to do so with trains travelling at speeds up to 15 miles per hour, it would be understood that the constant slowing down of an express train to 15 miles an hour seriously affected the mean speed. A system had, therefore, been devised by which the staffs were taken in and delivered by the drivers with the trains travelling at full speed, the apparatus used being almost identical with that used for receiving and delivering mail bags from and to mail trains.

Turning to the subject of the electric lighting installations under his care, the author said that the overhead cables in connection therewith had been from time to time adversely criticised, principally from an æsthetic point of view. He, however, considered that the overhead system had much to commend it for use on railway systems, particularly in the neighbourhood of railway stations and goods yards. Alterations in roads, sidings, &c., were fairly numerous, and it frequently happened that underground cables had to be diverted or removed, which was a troublesome and expensive proceeding. He had found that very many faults occurred in cable systems laid along or in close proximity to railroads. This was undoubtedly due to failure of joints (and joint boxes were particular offenders), owing to the heavy weight of trains passing over and disturbing the soil, also to the pounding of the metals. Cases were instanced in which all joint boxes had been removed and the cables jointed up with lead sleeves plumbed over all before the troubles were obviated.

Mr. Whieldon next referred to some of the troubles which they had experienced in connection with the Sutton-Howth electric railway system. A matter which caused serious trouble was that, owing to the bad water supply they had at the Sutton generating station, scale 1 in. thick was formed on furnace tubes after a boiler had been in commission only six weeks. They next put in a softening plant, but after that had been working a short time, it was found that serious corrosion occurred. An analysis of the "purified" water showed the presence of nitric acid. Very many experiments were made to overcome this difficulty, and eventually, in conjunction with Dr. Jerwitz, the method adopted, which proved successful, was the use of zinc plates in the boilers. Prior to the adoption of this remedy, plaster casts were made of the pitted surfaces of the boilers; these had been retained, and now, from time to time, fresh casts were made so that by comparing the two it was an easy matter to ascertain whether the corrosion was still going on. Considerable trouble was experienced with the oil used in the engine chambers, presumably owing to the impurities in the water finding their way into the crank chamber. Various oils were tried, but experiments showed conclusively that the trouble was solely due to impurities being carried over and finding their way into the crank chamber. A curious point, and one which had not so far been elucidated, was that in some cases the water contained in the engine separators on being tested proved to be pure, while water obtained from the crank chamber at the *same time* was not so.

The author next discussed the training of men for the responsible position of driver. He was bound to say that many of the tram-car accidents—which, unfortunately, had become far too frequent of late—were, in his opinion, simply and solely due to the fact that the men placed in these responsible positions were insufficiently trained. The amount of training they had was negligible compared with that which the driver of an ordinary train received. The train driver spent several years as a cleaner, next several years—generally five—as a stoker on various classes of traffic, then goods driver, and after all that, he was, after examination, promoted to be driver of a passenger train. After such a training a man had a thorough knowledge of his engine, and would know how to act in case of breakdown or emergency, whereas the ordinary motorman,

in nine cases out of ten, entirely lost his head when an emergency arose.

The drivers on the Sutton-Howth railway received a very long training, and each one before he was promoted to be driver was able to dismantle and re-erect his motor truck. Such a man in charge of a tramcar would be able to *feel* whether his brakes, &c., were correctly adjusted on taking his car out of the depôt.

In concluding, Mr. Whieldon said that the railway electrical engineer in designing power stations for lighting and power must have considerable foresight with regard to future requirements, bearing in mind that with the increase of population, all sorts of additional station and hotel accommodation would be required, as well as power for operating signals and hoists, goods yard lighting, &c.

Lastly, Mr. Whieldon briefly referred to the running of main line trains electrically. He did not consider that electrical working would ever be adopted in Ireland, as the working costs would not be reduced sufficiently to warrant the increased capital outlay.

A vote of thanks was passed to Mr. Whieldon for his interesting address on the motion of Mr. W. Brew, seconded by Mr. J. W. Boucher.

London Students' Section.

On the 14th instant Dr. C. V. Drysdale delivered an address as chairman of this Section. He congratulated the members on the excellence of the papers read before them, some of which had been printed in the *Journal*. He had observed that most of the important inventions of recent years emanated from Germany and the United States, for example, in connection with power transmission and electric traction; whereas British engineers a few years ago were trying to prove that electric traction on main line railways was not feasible, German and American firms were doing their best to make it so, and had carried out a vast amount of experimental work, with the express object of securing the British main line contracts—these lines being by virtue of their great volume of traffic between large towns just the kind where electric traction should be first successful, and where it would soon come. In ten to fifteen years probably a hundred millions sterling would be expended on traction work in this country; how much of it would go to British manufacturers?

Similarly in electric lighting, modern history was one of absolute failure on our part to bring forward anything new, or even to compete successfully in the manufacture of carbon filament lamps. Tests made in his laboratory five years ago on 100-volt glow lamps nominally of 2½ watts per candle showed that the Continental lamps were better in both efficiency and life, though cheaper. But the carbon lamp seemed likely to become extinct except in small sizes, thanks to the researches of the Germans in connection with metallic-filament lamps, culminating in the Osram lamp with an efficiency of 1·08 watts per c.p. for a 32-c.p. lamp at the end of 1,000 hours. Great though these achievements were, it was the method of obtaining them that impressed him most; as wire-drawing these filaments was impracticable, a whole army of scientific chemists had been called on to devise other methods of manufacture. Only in telegraphy were we leading; in telephony we were following the United States.

In mechanical engineering the position of this country was much better; the birthplace of the steam engine had also seen the chief development of the steam turbine.

It might be said that this was a commercial country, and that the great thing was to make things pay; but a comparison of company finances here and abroad showed that poor dividends were paid here, whilst in Germany high dividends were paid, and in America the stock of the G.E. Co. stood at 180, though the company had recently raised an additional four millions of capital for extensions, and that of the Westinghouse Co. stood at 155.

Dealing with the influences tending to foster or impede industry, Dr. Drysdale referred to State action in the shape of protection, patent laws, &c.; while in some cases protection might be advisable as a temporary measure, every other means ought to be tried first, and not until they were certain that it was the only way of putting the industry on its legs would they be justified in agitating for it. In the matter of standardisation and research by the Government, they were lamentably behind the United States, Germany and France. In Germany several industries had been created by the work of the Reichsanstalt. In spite of the good work of the National Physical Laboratory, it had received very little support from manufacturers.

Regarding the relations between capital, labour and scientific knowledge, which were absolutely dependent on each other, and all essential to success, in this country they stood aloof and sneered at one another. The remedy lay in the hands of the capitalist, who ought to educate the workmen in his employ, to see that the rising generation was educated, and to make the interests of his workpeople assimilate to his own by some form of profit-sharing. Also, the surroundings of labour ought to be improved.

The severance between capital and science, a fruit of tradition in this country, was in striking contrast with their relations in Germany and America. Here, experience in the shops was regarded as essential, while in America the employers disregarded it; it was considered that if a young fellow had done well at college, he would pick up all the practical work as he went along. This was the training of several of the engineers in high positions in the General Electric Co., and it was not due to the superior training of the American student, for the students of the London Central Technical College were specially appreciated on account of their greater theoretical knowledge. The scientific man was not appreciated here, first, because enterprise was on too small a scale to afford scientific work without immediate returns; and, secondly, the employer in many cases was not well enough trained to have the instructions of the expert correctly carried out.

Primary education in this country was a shining example of inefficiency, especially from the scientific point of view.

Lastly, national custom had a great effect on industry; there was a tendency to start too many small firms, whereas the manufacture of electrical plant essentially required working on a large scale. This had been recognised in America. The multiplicity of such small businesses meant a smaller output for each, higher cost of production, and extreme competition. This was the principal cause of our want of enterprise; in Germany the huge firms could afford to experiment, and on occasion combined to carry out a specially large investigation, such as high-speed railway working. Either there should be an aggregation of electrical firms into three or four large companies, or greater specialisation by agreement between the firms.

As regarded the differences in workers and wages, he thought the output was very much in proportion to the wages, and British workmen should certainly score in industries where intelligence was needed.

As for themselves, a really good all-round scientific knowledge was indispensable to the engineer, and pure science must not be despised, however unpractical it might appear. First principles should be mastered, rather than details. A knowledge of French and German should be acquired, and the foreign technical papers should be read. Ethics, economics and hygiene should be studied. There were better prospects in the fields of telegraphy, telephony, insulation and cables, and in lighting, than in dynamo design. Let them not make riches their chief aim in life; they would be happier if they could feel that they had been of use to others as well as to themselves.

CORRESPONDENCE.

Letters received by us after* 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Commutator Insulation Defects.

We notice from the extract of the annual report of Mr. Michael Longridge, M.Inst.C.E., chief engineer to the British Engine, Boiler and Electrical Insurance Co., Ltd., in your issue of November 9th, on page 742, that he deems "micanite" unsatisfactory for use between commutator segments, and states that "pure mica" should be used. He also mentions that a better material is desirable for the end insulation of commutators.

We, as the largest suppliers of both "micanite" and "pure mica" for commutator work, wish to say that surely Mr. Longridge's statement that "micanite is unsatisfactory for use between commutator segments" is not correct, as this material is universally used for this purpose throughout the world. We even supply micanite segments in small sizes where "pure mica" would be the cheaper, to several large electrical concerns who prefer it to pure mica. On the other hand, we must admit that some engineers prefer to use "pure mica," but as the cost is so very great for the large sizes they are compelled to use "micanite segments" to keep down cost. In regard to the use of "micanite segments" leading to short-circuiting by carbon dust, we wish to emphasise the fact that we have never received a complaint of this nature *re* our micanite segments from any one of our numerous customers, and we deal with almost every electrical concern. All our commutator micanite is submitted to very heavy hydraulic pressure, and under our process there cannot possibly be any apertures in the material for the carbon dust to get between the layers of mica, if the commutator is properly assembled.

The edges of our "micanite segments" are smooth and solid. It must also be remembered that "pure mica" is not all of the same hardness, even though it may be of the same quality, whereas in our process of manufacturing "micanite segments" we soften the mica to the same degree, consequently there is never any fear of its not wearing down equally with the copper bars, as is frequently the case when pure mica is used. Numerous electrical engineers entertain the same opinion as we do that "micanite" for commutator segments, besides being cheaper for the large sizes than

"pure mica," is more suitable and gives far better results than "pure mica" does.

It is not at all clear that the 63 breakdowns mentioned by Mr. Longridge were caused by the use of "micanite"; in fact, we should say that his further remarks *re* dynamo commutators and micanite insulation tend to show that the 63 breakdowns were due to some other cause entirely.

In conclusion, we would say that in our experience we find that the general opinion of electrical engineers is that nothing could be more desirable than micanite, particularly for segments and for the end insulation of commutators, and that its qualities are unsurpassed for these purposes.

The Micanite and Insulators Co., Ltd.
M. Mohr, *Secretary.*

London, E., *November 19th*, 1906.

Since the carbonisation of commutator insulation is the most subtle fault to which an armature is subject, the high cold resistance of the fault (which is sufficiently low when hot to burn out the coil) being most difficult of detection, this subject becomes most interesting.

Mr. Turner's contention that the presence of oil in the commutator is the cause of the trouble appears to be supported by an observation in Mr. M. Longridge's report, wherein he states that no breakdowns to generator commutators had come under his notice.

The conditions under which generators operate are generally widely different to those which obtain with motors. The generators are invariably of the open type, and offer very little opportunity for oil to reach the commutator, while the attendant applies the wax-cloth at the slightest sign of chatter, consequently the generator commutator receives only what lubrication is actually necessary.

Contrast this with the motor at the other end of the system, invariably of the semi-enclosed type, the end bracket frequently festooned with oil thrown up by the edge of the commutator, which gets as much oil as the loose or absent oil flirt will allow.

While it is comforting to be assured by such an eminent authority as Mr. Turner that good micanite is a good material for commutator insulation, still, since oil will find its way to motor commutators, what appears to be required to settle the case is a chemical investigation and demonstration that lubricating oil has not the property of liberating the acid elements of the sticking compound used in the micanite, or that these elements are not in themselves capable of reducing, say, the silicon (of which mica is so largely composed) to the troublesome and closely related carbon, even with the assistance of current and heat.

Some oils will readily carbonise under heat, but the writer has found commutator insulation in some places to become carbonised to a depth of $\frac{1}{2}$ in., while the rest of the insulation, although having absorbed much oil, remained unaffected.

Perhaps, however, it is well to remember that micanite, unlike grammar, can be graded, and that there is such a thing as bad micanite.

A. E. Vickery.

Plymouth, *November 19th*, 1906.

In reference to the use of micanite for commutator segments, I must say that I think it is a most unsuitable material to use. We have a number of motors with micanite segments, and they have given great trouble. The oil has got in, and the process has been much as Mr. Turner states in his letter. First of all, a small pin hole burnt away, which has rapidly got deeper, until the armature coil has been almost completely short-circuited. Out of some 70 motors, only those having micanite insulation have caused any serious trouble. These faults have not occurred on any particular motor, but on several running under widely varying conditions. Commutators with mica segments are running under identical conditions, and show absolutely no signs of the insulation burning away. As regards the use of silicate of soda and powdered mica which Mr. Turner recommends, I have tried this, but could never get it to set really hard. After the motor had been running a short time most of it would fly out, and the only remedy has been to rebuild the commutators. Perhaps Mr. Turner could give some assistance on this point. I think motor manufacturers would do a great deal of good if they would only design their oiling arrangements with more thought of the above trouble arising. With the craze for solid brasses, and everything as cheap as possible, the motors of to-day are in many respects much inferior to what they were, say, three or four years ago. I think an oil splash ring, or even two, of a *fairly large diameter* would stop most of the leakage which causes the commutator troubles. But even then mica is far better than micanite, as is proved by the fact that nearly all motor makers use mica. I hope this discussion will not drop, for it is a most important question.

F. Wardrobe.

Sheffield, *November 26th*, 1906.

Exhibitions at Olympia.

"Lest we forget" before the next show the annoyance which all have suffered from the dust this year at Olympia, would it not be a wise plan for the Society of Motor Manufacturers and Traders to make some decision at once for the betterment of this disagreeable condition for next year?

If the aisles were covered with cocoanut matting and lightly sprinkled with water as in the Paris Show, there would be very little flying dust. Not only is the dust bad for exhibits, and unpleasant to exhibitors, especially ladies, but it creates a most unwholesome atmosphere for those engaged constantly at the show for ten days.

The condition of nervous exhaustion known to all concerned in the show, due to the confinement and long hours, is greatly augmented by the bad ventilation and dust-laden air.

The object of the show is to exhibit and sell cars, and motor cars are not bought in a moment like cigars, and no one will remain long in a fetid atmosphere who does not have to, and a lack of attention to the seemingly small details of ventilation and cleanliness will in many cases drive buyers away, and defeat the purpose for which the show is established.

No effort should be spared to make next year's show as comfortable as this one has been brilliant and successful.

Adams Manufacturing Co., Ltd.
A. H. Adams, *Managing Director.*

London, E.C., *November 26th*, 1906.

Advertising in Electricity Works Pamphlets.

I have read with interest and some surprise the letter of "Publicity Department Manager" on the subject of advertising in electricity works pamphlets.

There is a good deal of truth in his remarks. There is also something to be said on the other side. But it is not, in my opinion, a matter to be discussed in the Press; and I would go further, and say that no matter affecting publicity work or the management of publicity departments should be the subject of public discussion.

With the latter part of his letter I am in cordial agreement, and should be very pleased to improve my acquaintance with fellow managers through the medium of some such society as is suggested.

Protectionist.

With reference to the suggestion of your correspondent, "Publicity Department Manager," and your editorial note thereon, there is no doubt that such a society would not only be beneficial to its members from a point of view of interchange of ideas, but also as forming a protective association against undue pressure being brought to bear when canvassing for an advertisement such as instanced by your correspondent.

I am strongly of the opinion that if you are willing to use your influence some such society would be an unqualified success, and I should like to suggest that if you could see your way to send out a circular letter to those of your advertisers who retain the services of a publicity manager, an indication of the general feeling would be arrived at. If the opinion were favourable, as I feel sure it would be, to the formation of a society, a preliminary meeting could no doubt be arranged; but I think that only by a disinterested party carrying great weight, such as yourselves, acting as organisers can we hope for any measure of success in this direction.

Simplex Conduits, Ltd.
ALAN D. ROBINSON,
Publicity Manager.

Birmingham, *November 26th*, 1906.

I noted with interest "Publicity Department Manager's" suggestion in your "Correspondence" columns of last week to the effect that a "Society of Managers of Electrical Publicity Departments" should be formed, as I agree with the writer that such a society would be of great benefit in the further development in the use and popularisation of the products of the electrical industry.

I would suggest that the editors of the ELECTRICAL REVIEW propose an evening for the preliminary meeting, and that it be held in London, at a place to be decided upon after the editors have heard from those to whom the formation of this society more directly appeals.

The editors have kindly offered their assistance, and now it is only "up to" the parties interested to communicate with them.

R. B. M.

[We regret that the fifth word from the end of the first paragraph of "Publicity Department Manager's" letter in our last issue was misprinted; it should have read "useful." The wording of the next line implies this meaning.—EDS. ELEC. REV.]

Prepayment Meters.

I should be obliged if, in your answers to correspondents, you would be so good as to let me know in your next issue the names of the various electric lighting authorities in London and the suburbs who have adopted automatic machines by the use of which 1d. placed in a slot provides for a limited supply of electric light.

A. J. P.

[Perhaps some of our readers will kindly furnish information on this point.—EDS. E.R.]

Deposits with Tenders.

I should be glad of an expression of opinion as to the propriety of the custom which obtains with some municipal treasurers, of paying in to the Bank cheques sent by contractors as deposits for specifications to which they propose to tender.

I am not fully acquainted with what is considered the proper custom to adopt, but cannot conceive any justification for the practice above mentioned, which is open to obvious and very grave objections.

Contractor.

Rail Corrugations.

Mr. Harvey's most interesting letter in your issue of 16th inst. makes one feel that the explanation of the mystery is not far off; but I cannot follow his reasoning in the current issue to the effect that a *ratio* of areas should be the same figure as the pitch in inches of the corrugations. Further, it is difficult to see how horizontal buckling of the web could produce vertical buckling of the head.

Another possible, and to my mind highly probable, explanation I have not seen touched upon by any of your correspondents; so I venture to submit it for criticism. It is that, owing to the necessity for strong thick teeth in their gearing, the rolls are driven, not smoothly and regularly, but in a series of jerks, and so produce a surface of undulating hardness, if I may be allowed the phrase. An even-wearing action over such a surface would, of course, remove an undulating thickness of material, and leave a corrugated surface. This theory would account for the regular horizontal buckling of the web on contraction, as well as for the vertical wear; and the pitch of both seems to fit in with it.

Perhaps some correspondent in practical touch with the work of rolling will be good enough to give his views.

If this explanation is the true one, worm driving would seem to be the cure.

W. S. Boult.

London, S.W.,
November 23rd, 1906.

I have followed, as a continual reader for many years of the ELECTRICAL REVIEW, the question of rail corrugation, especially in your current issue, where Mr. H. Boot, of Tunbridge Wells, complains of certain correspondence in reply to his much-questioned theories, and treats your readers to a dissertation on his past appointments and capabilities, indulging, I consider, in uncalled-for personalities, which have nothing to do with the general argument in question, being, in my opinion, very bad form. I think that your columns rightly are open to legitimate argument for the benefit of the electrical fraternity, and such is the purpose for which you publish our letters.

There is no reason to be rude in dealing with any engineering query: personal abuse surely prevents sound reason, and in its place substitutes no more than nonsense.

When a man loses his temper, for the sake of all parties concerned he would be well advised to take his gloves off, otherwise he runs a risk of getting somewhat punished.

R. B. Leach,
Chief Engineer and General Manager.

Farnworth Electricity Works,
November 24th, 1906.

[As our correspondent quite rightly observes, we open these columns for the advantage of our readers, and we strongly deprecate digressions from practical questions of general interest into matters of a purely private and personal character. We might intervene for the purpose of excising personalities; but we are unwilling to do so if it can be avoided, and we trust that our correspondents as far as possible will refrain from such allusions, which are both unprofitable and in bad taste.—EDS. E.R.]

I enclose herewith two photos showing the corrugations in the web of a rail, but I am doubtful if they show up sufficiently plainly for reproduction, as it is a particularly difficult matter to get a distinct view.

L. E. Harvey.

Sunderland,
November 24th, 1906.

[The corrugations are very distinctly visible on the original photographs; but it is very difficult to ensure their satisfactory reproduction by the half-tone process. However, we have endeavoured to accomplish this, and the result will be found in our "Notes" columns.—EDS. E.R.]

In my opinion the most valuable information set forth by the observation of Mr. Harvey is the fact that corrugations exist in the rail before it is installed. This very strongly points to the assumption or theory that the conditions for corrugations originate in the rolling mill.

In reference to the area or comparative weights of metal, I find (steam railway rails) that the proportion of weight in head, web and flange of Mr. Sandberg's "Goliath" rail of 1889 was 45·5, 22, and 32·5 per cent. respectively. The American Committee recommended 42, 21, and 37 per cent. respectively.

I have not at hand the exact percentages appertaining to tramway rails. Personally, I do not consider that the area or relative weights of the web, flange or head have anything whatever to do with the "pitch" of the corrugations.

The effect of unequal rates of cooling (consequently contraction) in the different sections is to induce internal strain and to make the head of the rail spongy.

Rails are not always straight after cooling, and warp or bend on curves of large radii, and it is impossible to conceive that any contraction (due to unequal cooling) would result in a form so as to produce a number of waves of small radii or short pitch.

The resistance to expansion or contraction would, to my mind, be least in a direction along the total lineal length of the rail, rather than the practically comparatively greater internal line of resistance suggested by a wave of short "pitch," viz., approximate 2½ in., consequently the rail would assume an all over bent or bowed condition.

I fail to see why rails rolled on a cold day would induce corrugations any more quickly than those on hot days. In a rolling mill, the rails do not leave the rolls in a highly heated condition and drop directly on to the metal plates of the floor, for after passing through the finishing rolls they are carried on live rollers and sawed into the proper lengths, after which the rails are laid cambered on hot benches so as to gradually cool at a slow rate, and to be afterwards straightened while cold. In his letter of this week I do not agree with his suggestion of bad mixing of the molten metal. Steel smelters and manufacturers are too expert in their business for there to be a weakness under this heading; in fact, from a metallurgical point of view, the very process to which the metal is subjected causes a thorough mixing.

In my opinion, corrugations originate at the rolling mill, and are primarily due to defective rolling, *i.e.*, the absence of prolonged rolling at low temperatures, on which I laid such great stress in my letter of July 27th, 1906.

Some rails may no doubt leave the rolls at higher temperatures than others, and corrugations are thereby formed while hot, and my theory is that the corrugations are formed by the rolls (the rails leaving the rolls at too high a temperature), the pitch being a function of the diameter of the rolls and the speed at which the rail travels through.

There is not the least doubt but that a neglect of prolonged rolling induces a lack of the all-important and essential condition of homogeneity of the molecular structure of the rail, as also will strains produced by unequal contraction due to different cooling rates.

When the above conditions exist in the rail before installation, it is only a matter of time before the practical every-day working conditions will magnify the defect; and the rapidity of development will obviously be determined by the method of installing and other engineering conditions.

In my opinion, Mr. Boot is supporting a very weak theory as to rail corrugations being effected by sparking. To my mind, sparking does not, either directly or indirectly, assist corrugation effects in any way whatsoever.

As a remedy, I suggest that prolonged rolling of the rails will prevent them leaving the mill in a corrugated condition.

Wm. R. Bowker.

Manchester, *November 24th*, 1906.

Nernst Lamp Renewals.

In the recent correspondence about Nernst lamps in this paper, the statement was made that the annual total cost of Nernst lamps could not be calculated beforehand, and that our guarantee of three burners per lamp per annum was fictitious, and not supported by actual results. The Corporation of Chester adopted maintenance of consumers' Nernst lamps under our guarantee about 18 months ago, and Mr. Britton has kindly allowed us to publish the following results:—

Number of lamps installed	108	B-type (U-shaped filament)	
" " "	25	D-type "	"
" " "	29	½-ampere Luna	
" " "	24	1-ampere Luna	
Total number =	186		

The above 186 Nernst lamps were in use on a direct-current circuit of 220 volts (210-volt burners, and 20-volt resistances). Polarity was carefully observed, and "three-pin" B. and D. lamps used throughout.

Average lighting hours per annum = 1,092.

Average life of burner = 682·5 hours.

Average number of burners actually used per lamp per annum = 1·6.

The charges made by Chester Corporation for maintenance are as follows:—

½-ampere B type	4s. 6d.	per lamp	per annum.
½-ampere Luna	6s. 0d.	"	"
1 " "	9s. 0d.	"	"

which is three burners per lamp at gross prices.

The above results show that where Nernst lamps receive proper attention they will do exactly what we claim, *i.e.*, that including cost of maintenance they are much more economical than any other electrical glow lamp on the market. Corporation and electric light companies will find maintenance of Nernst lamps the best means of competing with incandescent gas, and it reduces the cost of lighting to consumers. There is no risk attached to it, as our guarantee effectively protects them against any loss.

The A.E.G. English Manufacturing Co.

London, W.C., *November 26th*, 1906.

The Absorption of the Atmosphere for Light of Different Wave-Lengths.

Mr. J. S. Dow, writing under this heading in your issue of November 2nd, starts his article with the statement "that the general belief up to now has always been that rays of long wave-length penetrate the atmosphere best." Later, he proceeds to argue that because the atmosphere is known to conduct the long wave-lengths, such as Hertzian waves, better than the short ultra-violet waves, therefore the atmosphere must also conduct red better than blue light. This deduction of Mr. Dow's is altogether unsupported by evidence, and I might just as legitimately argue that because the atmosphere—air, and water vapour—is very opaque to radiant heat, it must also be somewhat opaque to red light, but, much as I should like to use the argument, I do not know of any scientific evidence to justify it.

The fact that the atmosphere is practically opaque to radiant heat is, however, a conclusive argument against the general law that Mr. Dow claims to have discovered, namely, that the transparency of the atmosphere increases as the length of the wave increases.

It must always be remembered that the action of perfectly pure, dry air is entirely different to that of atmospheric air, which always contains a percentage of water-vapour, and it is probable that the laboratory experiments referred to in the article were conducted with carefully purified and dried air, and are consequently of greater scientific than practical value.

Mr. Dow asks me how I can explain the fact that the sun looks red on a foggy day. First of all, I must remind him that I have never maintained that the atmosphere conducts blue light *much* better than red, I have merely said that it conducts the one *somewhat* better than the other. Remembering this, we will imagine an illuminant composed of 60 per cent. red light, 30 per cent. yellow light, and 10 per cent. blue light, and for the sake of argument, we will represent the conductivity of the atmosphere for blue light by the figure 100, for yellow light 90, and for red light 80, and it is obvious that this illuminant, seen through a sufficient thickness of atmosphere, would appear red, owing to the

fact that there is most red light in its composition, and notwithstanding the fact that blue light is conducted somewhat better than the other two colours.

My solution of Mr. Dow's conundrum is, therefore, based on the argument that there is more red than blue in sunlight, and certainly the phenomenon is not evidence that red light is conducted better than blue.

There is one hint I would like to offer to Mr. Dow, in case he carries out his intention of experimenting in this matter, and that is, that he must remember that when he inserts resistance in circuit with a carbon-filament lamp, he not only reduces the illumination, but he also alters *the characteristic features of the illuminant*. The spectrum of an under-run carbon filament is quite different to that of an over-run filament, and cognisance of this fact will, I believe, help to explain the results which he published in his paper before the Physical Society, entitled "Colour Phenomena in Photometry," whereas he ascribed them, as I think, wrongly, to the Purkinje effect alone.

Referring to my contention that light from diffused sources penetrates a fog better than light from concentrated sources, Mr. Dow fairly gives away his case. He says, "In a really bad fog, glow lamps can often be seen in the shop windows, while the powerful shaded arcs outside the shop are invisible."

Now, he could not have cited a better example in support of my views, because the only difference in the character of these two illuminants is what he terms the concentration of the light (or the light density at the source, as I prefer to put it). In both cases the light is emitted by incandescent carbon, and yet the small glow lamp penetrates the fog better than the powerful carbon arc, and I ask why, in the name of all that is reasonable, can this not be ascribed to the fact that the light density on the carbon filament is only about 200 c.p. per sq. in. of surface, and the light density in the carbon crater is about 50,000 ?

The light density in the arc is not reduced by surrounding it with a ground-glass globe, as Mr. Dow suggests, and the great proportion of the luminous rays are absorbed in the immediate proximity of the arc before they reach the globe, as is evidenced by the local high temperature.

I am afraid I have already trespassed too much on your valuable space, but I would like to remark that, in my opinion, Mr. Dow uses the expressions infra-red and ultra-violet in far too loose a way. For example, I doubt very much the correctness of his statement that alum solution is almost completely impervious to infra-red rays ; he should have said calorific rays.

C. Orme Bastian.

London, N.W., *November 26th*, 1906.

There are people who believe that certain particular colours preside over, or have something to do with, certain particular months. I don't know whether they are astrologers, or magicians, or what they are.

One of these persons divined that yellow would be my lucky colour, and I asked him what colour was best for penetrating fogs. He advanced the opinion that this was a matter which depended on the time of the year. I noticed, myself, that yesterday the sun was red through the mist when I was going to church.

I decline to assume responsibility for the gentleman's theory, but should like to know what Mr. Bastian, and your other correspondents, who have been writing about the penetrating qualities of the mercury arc light, think about it.

Azit Tigleth Miphansi.

Wireless Telegraphy.

To anyone conversant with the subject of wireless telegraphy, either in its technical or commercial aspects, it is so obvious that the article "communicated" to your issue of November 16th is incorrect, that it bears its own refutation. As, however, the subject has not received as much general attention as its importance might appear to justify, and as a number of statements are made affecting our company, you will, perhaps, permit me to make a few corrections of the assertions of your contributor.

In referring to the fact that "different forms of apparatus will be found best adapted to different cases," he speaks of the failure of the Marconi apparatus in Somaliland. No apparatus was ever supplied by our company for use in Somaliland. It is possible that Marconi apparatus taken off a man-of-war may have been tried there, but not apparatus recommended by the company as suitable for working overland, under conditions likely to obtain in such a country.

Nor is it correct to conclude that for overland working, where the soil is of variable conductivity, no apparatus is satisfactory in which an earth connection is used. We have a number of installations in different parts of the world, working satisfactorily overland, where the soil is of variable conductivity, with which an earth connection is employed.

Your contributor, after making the very obvious statement, "it is certain that different forms of apparatus will be found best adapted to different cases," apparently fails to realise that apparatus taken, for example, from a ship, may not prove satisfactory for land working for reasons of design rather than of principle. Earth connections are used, and successfully used, for overland and oversea working under all conditions, but Poldhu would not make a good portable station for military purposes, nor is a motor-car set specially suitable for a lightship.

In speaking of secrecy, he says :—"Any and every system that has yet been devised, pours out ethereal waves into space around the transmitter. Whether the transmitter is tuned or untuned, any proper receiver within range will pick up some of the waves." That statement is incomplete and misleading. There are means of transmitting the waves with maximum intensity in a particular direction, and with a given amount of energy the range along the line of maximum intensity is several times greater than the range along the line of minimum intensity. Messages transmitted, for example, from Cape Breton to ships in mid-Atlantic may not be received at all at a station only a few miles from Cape Breton, even when that station is tuned similarly to Cape Breton. Tuning, therefore, if only a partial remedy against interference, is not the only remedy.

It is incorrect to say that the Admiralty "is not compelled to purchase any more apparatus from the Marconi Co. except jiggers and trays of Leyden jars." There is other wireless apparatus which is not at the disposal of the Admiralty unless purchased from the Marconi Co.

It is misleading to say that the British Admiralty "which began with the Marconi system, is gradually developing its own." The company has licensed the Admiralty to use its patents, and receives an annual payment for their use. It contracts to keep the Admiralty *au fait* with developments and improvements, and to instruct Admiralty officers. This instruction is an important feature of the company's present agreement with the Admiralty. Its original contract provided only for the supply of apparatus ; this arrangement was not found adequate for the Admiralty's needs, and a special feature of the Admiralty contract now in force is instruction and information by the Marconi Co.

The Italian Navy uses the Marconi system because it thinks it the best—a fact which it has declared on more than one occasion officially and publicly—not "for reasons laudably patriotic."

The Lloyd's contract with our company recites :—"And whereas Lloyd's is of opinion that it is desirable that one system of wireless telegraphy should be in general use, and whereas the Marconi system is in such general use and has been proved to the satisfaction of Lloyd's to be a good working system. . ."

This recital shows the reasons which actuated Lloyd's in making an exclusive arrangement with the Marconi Co. Similarly, it would hardly have been thought improvident 20 years ago to make a long term contract with the National Telephone Co. to use its system because improvements in telephony might conceivably be made by persons outside the telephone company.

The statement made with regard to the number of stations of the Telefunken, judging from other statements in the article, is incorrect. The statement made with regard to the number of Marconi stations throughout the world is very wide of the mark. It is not 400 ; nor does twice 400 adequately represent the number.

The comparison instituted between the Telefunken and Marconi Companies on the basis of "number of wireless stations over the world," is, however, apart from the incorrectness of the figure, valueless, and shows that your contributor entirely fails to grasp the subject with which he purports to deal. He is discussing the Wireless Telegraph Conference, and appears to conclude that this question is to some extent affected by the number of stations throughout the world installed by the different companies respectively. The number of stations *per se* has, however, no bearing whatever on the matter. Apart from the technical merits of the different systems, which I will not here discuss, the use to which the stations are put is of primary importance. The Marconi Companies, apart from their manufacturing business, are carrying on a public telegraph service by means of wireless telegraph apparatus—transmitting the messages of the public on payment of a rate. All the principal steamship companies using wireless telegraph apparatus carry the Marconi — German, French, Belgian, Dutch, Italian, American, Canadian, English—the apparatus is installed by the company and worked by its own operators for a message rate, and it has a large organisation of coast stations for the same purpose. To compare the Marconi Companies with the Telefunken in this connection is as fallacious as to compare a public telegraph company with a manufacturer of telegraph instruments.

Your correspondent continues: "This being the state of the art, it is not surprising that in the interest of the merchant services of all nations, it has been found desirable to establish some general understanding." As practically all the ships carrying wireless telegraph apparatus are fitted with the Marconi apparatus and worked by the Marconi Co., the necessity for some general understanding with regard to ship-to-shore communication is not very evident.

The commanding position which the writer of the leading articles in the *Times* assumes Great Britain to hold through the operations of the Marconi Co. is strictly correct. The *Times* was discussing the ship-to-shore communication. All the big steamship companies have Marconi apparatus, and the Marconi Co. controls the only organisation for communication with these steamship lines. In this service the Marconi Co. has not been outstripped by its rivals; it has no rivals; and it is absolutely incorrect to infer that the other companies have covered the globe with stations which are carrying on a public telegraph service for ship-to-shore communication—the service under discussion by the Conference.

What is politely described as the dog-in-the-manger policy of the Marconi Co. is a policy absolutely identical with the policy pursued by every other public telegraph company. If your contributor would take the trouble to inform himself on the subject, he would find that all public telegraph companies transmit the messages of the public by means of their own apparatus in accordance with rules and regulations which they think to be in the interests of the service. The Marconi Co. refuses to allow any ship fitted with apparatus not supplied by the company or worked in accordance with its rules and regulations, to establish communication with its system. Inland telegraph companies do not permit any member of the public to attach telegraph instruments to the inland telegraph systems and transmit messages over their lines. Your contributor will find that if he proposes to one of the trans-Atlantic cable companies that he should connect his own instrument to the company's system and transmit his own cablegrams over its cables whenever he wants to communicate with the United States, he will be laughed at. The "dog-in-the-manger" policy of the Marconi Co., which, by the way, has resulted in a service for ship-to-shore communication which is not only unequalled, but which has no rivals, is absolutely identical with the policy of a cable company or inland telegraph company in this respect. All public telegraph companies make the use of their system public; they operate their lines themselves by means of their own apparatus.

Your contributor, for some reason which is not made apparent, but which a revelation of his identity might disclose, appears to be rather sore at what he describes as "the inflammatory suggestions of the Marconi Co. through the daily Press to prejudice the situation at the Conference." The plain facts of the matter are that the daily Press, including the *Times*, *Morning Post*, *Standard*, *Daily Telegraph*, and *Daily Chronicle*, contained grave notes of warning of possible prejudice to British interests which might result from incompetent representation at the Conference. That these warnings were not without justification is shown by the fact that whereas Germany got all she wanted, several important proposals of the British delegates were politely, but firmly, declined. We were informed through the Press that the British delegates were practically ruling the Conference. "Ruling the Conference" was talking a great deal and getting their proposals rejected. They appeared to plume themselves particularly on the fact that they had made special reserves. Obviously, any State could make reserves, even Monaco, whose vote, by the way, had exactly the same weight as the British vote. Among the powers which they reserved to themselves was the right to compensate out of the British taxpayer's pocket an organisation (the Marconi), which, they pointed out, would be in jeopardy from intercommunication with heterogeneously equipped ships.

Many of the papers contained special articles, letters from well-known men, and special correspondents' telegrams, commenting in no very favourable terms upon the British delegation. Some of the French and Italian papers took a similar line. If your correspondent finds it easier to assume that these leaders, and special articles and letters signed by well-known men, were inspired by the Marconi Co., than that the British delegates were not proving quite as efficient as they themselves declared, I would suggest that the special declaration which the British delegates were instructed to make at the conclusion of the Conference, that the British Government was to be held to be in no sense bound by their conclusions, was an indication of a view more tenable, though less gratifying to their *amour propre*, than that which appears to be entertained by your contributor.

The reference of your contributor to Government contracts with the Marconi Co. seems to indicate more than a nodding acquaintance with Government departments. Perhaps, therefore, a little further search, for which he may have facilities, will enable him to elucidate the fact that before the Berlin Conference, the Marconi Co. gave notice to the Government that its legal advisers do not put the interpretation upon the Post Office contract which your contributor puts—an interpretation to which his strong resentment of the alleged action of the Marconi Co. is ostensibly attributable.

Your contributor makes improper accusations against the Marconi Co. of un-English actions. Such an accusation does not come well from an anonymous writer, whose courage, even by this reflection, will, I fear, hardly be roused into sacrificing the protection of his anonymity.

Marconi's Wireless Telegraph Co., Ltd.,
H. Cuthbert Hall, *Managing Director.*

London, E.C., *November 27th*, 1906.

Suction Gas Power.

You robbed our last letter of a part of its value in not reprinting the Table we sent you giving the initial cost of the steam and gas plant at Guernsey. If you will refer to the Table we sent you will see that the *actual* costs for one set were as follows:—Steam power plant, £3,642; gas power plant, £3,200.

We presume you do not wish us to take up your space by repeating further details, but the above are essential in order that you and your readers may understand, to some extent, the false premises on which the conclusions in the communicated article are based. You will see from the above that the gas power plant cost less than the steam power plant, whereas the article in question assumes it cost over 50 per cent. more.

As regards the remarks in your footnote, the following further figures received by us give *actual* costs for the quarter ending March, 1906, when, as you will note, the steam station had a rather larger output than the gas station.

	Steam plant. Lighting load. Per unit generated.	Gas plant. Power load. Per unit generated.
Coal	·391	·151
Stores	·027	·046
Wages	·209	·136
Repairs	·207	·176
Total works costs ...	·834	·509
Units generated	164,323	162,438
Coal cost	16/2 per ton.	15/6 per ton.

The other figures in the table which you did publish in your last have not been sent us for the above term.

The engines are four-cylinder vertical gas engines, the type your correspondent quoted in his article.

The Campbell Gas Engine Co., Ltd.
HUGH CAMPBELL.

Halifax, *November 26th*, 1906.

[We were not aware that our correspondent intended us to reprint the matter in question, which gives no further details of capital cost than those quoted above. It forms part of the paper mentioned last week, and was printed in full in the issue to which we referred.

The data given by Mr. Campbell are of great interest. Figures derived from actual practice are of course much more valuable than any estimated figures can be.—EDS. E.R.]

"EVERBRITE."—A correspondent wants to know the name and address of the makers of "Everbrite" silvered glass reflector shades.

FARADAY MEMORIAL.

IT was on Saturday afternoon last at Barnsbury. The place an oblong room—large for a room, small for a chapel. On one of the shorter walls a metal tablet, simple in design and direct in the message it conveys, befitting the name it bears. The position which it occupied was obviously not chosen with any view to architectural effect or pictorial balance, for it was rather out of the centre, to the spectator's right hand. Around the room a telephone switchboard of the most modern type, with its relays and its lamps. The operators were busy with their plugs and spring jacks switching the lines for the transmission of "winged words" from subscriber to subscriber; attending strictly to duty and impervious to the distractions of an unprecedented occasion. But even so it were unwise to prolong these distractions unduly, and our presence in this room must be brief. Lord Kelvin touched an electric button, and simultaneously the curtain was withdrawn, revealing a tablet with the following inscription :—

Erected by the
Staff of the
National Telephone Company, Limited,
To Commemorate the fact that
MICHAEL FARADAY used to Worship here
From 1862, till the Date of his Death in 1867.
From 1862 to 1899 this building was
The Meeting House of the Sandemanians,
Of which Body Michael Faraday was an Elder.
This Plate marks the position
Which he usually Occupied on the Platform.
The position of his Pew is indicated by
A Plate on the Floor.
Unveiled by the
Right Hon. Lord Kelvin, O.M., P.C., G.C.V.O., F.R.S., LL.D., &c.
24th November, 1906.

What a fount of inspiration does such a conjunction provide! Faraday's chapel a telephone exchange! The scientist who made the great discovery of magneto-electric currents worshipped and preached in this room which is to-day occupied by exemplars in the highest form of the practical applications of his labours for science. How apposite Lord Kelvin's quotation of the words beneath the name of Wren in St. Paul's Cathedral—"Si monumentum requiris, circumspice." And how simply did he—who, as Dr. Thompson told us, handed on the torch of science from Faraday's day to ours—how simply did he give us the application. "Look around. These walls tell a story not of a magnificent cathedral but of the humble meeting house of simple, earnest, Christian men." Again—"Look around and see the telephone at work. And that is a monument to Faraday." Lord Kelvin told us, too, how Faraday was the inspiring influence of his early love for electricity, and the willing helper, the kindly encourager, of later years. He spoke with feeling, simple, eloquence; and as he related how Faraday's inspiration dated from 66 years ago, and as he recalled the principal applications resulting from Faraday's work, we could not fail to be grateful to this veteran of science for his inspiring words, and to recall in mental picture his own inspiring deeds. It was in a lower room that the speeches were made, a room which had the power plant, the distribution boards, and the cells of "central battery" for its immediate neighbours. Sir Albert Rollit welcomed the guests on behalf of the directors of the company, and told us that the happy thought of this memorial originated with the staff, and not with the directors. Mr. Gill outlined the history of the memorial, and detailed the steps in verification which had been taken since the idea occurred that there might be some relation between the chapel the company had purchased and the Sandemanian meeting house mentioned by Dr. Thompson in his life of Faraday. Sir Joseph Swan expressed his gratification at taking part in so interesting a ceremony, and then Dr. Thompson, who has paid his tribute in print to "the man whose influence upon the century in which he lived was so great," asked our thanks to that other great man who had come to unveil the memorial. Dr. Thompson imposed upon himself a self-denying ordinance. He did not draw on his stores of Faraday lore, but with graceful tact left to the grand old man of science of to-day the eulogy of that other great scientist of the past. He contented himself with showing how Lord Kelvin linked Faraday to our own times, and thus was the torch of science handed on from age to age. We thanked Lord Kelvin, and the National Telephone Co., and Mr. Gill and Mr. Clay, but we did not give expression to a tithe of the gratitude we felt for the privilege of participating in so interesting and informing a ceremony. We had been taken back in spirit to the very beginnings of our great industry, and contrasted the mighty forces of to-day with their progenitors in the discoveries and experiments of the past. And not the Things only, but the Man. He who was ever probing and proving the truths of science, adopted with simple faith the primitive principles of a small religious sect, in whose declarations of belief there is no room for "the higher criticism." And the Sect which regards the accumulation of wealth as inconsistent with religion must have its share of credit for the value to Science of Faraday's unselfish nature and simple life.

In addition to those already mentioned, there were present Lady Kelvin, the Misses Barnard (Faraday's nieces, of whom one acted as his secretary), Miss Swan, Mr. Harold Faraday and Mr. John Barnard (nephews); Dr. Glazebrook (President), Mr. Mordey (Vice-President), and Messrs. Harrison, Judd, Kingsbury, and Mather, members of Council of the Institution of Electrical Engineers; Mr. Trotter, Dr. Walmsley, Mr. Raphael, and a large number of the staff of the National Telephone Co., amongst whom we noticed Messrs. Goddard, Cook, Coleman, Phillips, Fletcher, Gall, France, Stuart, Cohen, Poole, Elliott, Cole, Laidlaw, Aston, and Smith.

LEGAL.

ACTION AGAINST AN ELECTRICAL ENGINEER.

ON Wednesday last week, in the King's Bench Division, Mr. Justice Bray tried the short cause of Bearcroft *v.* Turner.

MR. MINTON SENHOUSE, plaintiff's counsel, stated that the plaintiff sought to recover from the defendant the sum of £116, principal and interest on a bill of exchange. Defendant was in business in 1903 as an electrical engineer at New Broad Street, and in June, 1903, a partnership deed was entered into between plaintiff and defendant. It was agreed that each partner should bring £500 into the business. The business was carried on for a year at a loss.

The plaintiff brought his £500 into the business, and his (counsel's) instructions were that the defendant had brought nothing into the partnership. Plaintiff had lent the defendant various sums, and he now sued on the bill of exchange given him by the defendant.

The defence set up was that it was understood between defendant and plaintiff that he (defendant) was under no further liability either to plaintiff or the firm after the dissolution of the partnership. Plaintiff was called and gave evidence in support of his counsel's opening statement.

Cross-examined: At the time defendant was trading as Turner and Co. The dissolution of partnership was duly advertised in the *Gazette*. Plaintiff had not pressed for his money before, as the defendant had said he would pay.

Mr. Sturgess (for the defendant) said his story was that the defendant gave up everything in the partnership in consideration of all the liabilities, and the bill being taken over by the plaintiff.

Defendant, an electrical engineer, now a chief inspector under the London and South-Western Railway Co., was called, and said he formerly traded as Turner & Co., at Ebury Street and New Broad Street. He made a profit of £200 a year, but making a bad debt of £600, he became handicapped for capital. He explained this to the plaintiff prior to his entering into the partnership. When he retired from the business, plaintiff agreed to take it over.

His Lordship said, upon the evidence, he could not say that there was any discharge of the defendant from the debt in question. He could find no agreement that the defendant was to be discharged from liability under the bill.

Judgment for the plaintiff for £116, with costs, plaintiff abandoning the claim for interest.

Electric Accumulator Co., Ltd., *v.* F. W. Berk & Co.

This case came before Mr. Justice Channell in the Commercial Court on Tuesday and Wednesday last week.

Mr. A. J. Walter, K.C., and Mr. McGowan appeared for the plaintiffs; and Mr. Roche for the defendants.

Mr. Walter said this was an action for damages for alleged breach of warranty on the sale of acid by the defendants to the plaintiffs to be used by the latter in electrical accumulators. It appeared that in March last defendants submitted to the plaintiffs samples of acid which was said to be free from impurities, and in particular free from iron. Plaintiffs ordered 12 carboys of the acid from the defendants on the basis of the quality of the acid shown as sample, and of its freedom from iron and other materials. The acid supplied was said to be of a quality equal to the sample. The order given was for 12 carboys of concentrated oil of vitriol of the same quality as the sample submitted to the plaintiffs. The plaintiffs said that the defendants had knowledge that they were manufacturers of electric batteries, and that the acid was for that purpose. The oil of vitriol was delivered and taken into immediate use, as the plaintiffs were in urgent need of it having to supply the Admiralty and other public bodies with accumulators. It was soon found that the acid was not of the quality guaranteed, and considerable damage resulted. Defendants denied the alleged warranty, and said the vitriol was sold by description as concentrated oil of vitriol and not otherwise. Defendants also said that the oil supplied was not impure and not unfit for the purpose for which the plaintiffs were going to use it. As against that, it was found that the acid supplied was not up to sample, and was quite unfit for the purpose for which the plaintiffs required it.

Mr. N. Opperman, the managing director of the plaintiff company, examined, said that in March, 1906, he received a call from Mr. Kershaw, representing the defendants, who took a sample of acid out of his pocket, and said it was a pure acid, and that there was no iron in it. Mr. Kershaw tested it in his presence, and witness suggested that a sample received earlier, should be tested. Both samples proved to be the same, and witness suggested that they should compare the sample with the acid they were then using, which was obtained from another manufacturer. The sample was slightly purer than the acid they were then using. He afterwards ordered a dozen carboys of the acid. These were delivered, and the acid was used in the manufacture of batteries in the ordinary way. They were out of acid at the time, and these carboys were taken into use at once. When the plates were formed, they did not have a good appearance, and when they were tried for capacity, they only gave 25 amperes per plate. After he discovered the defects, he communicated with the defendants, and Mr. Kershaw came down. Mr. Kershaw said he was sorry, and that the carman had probably made a mistake, and delivered the wrong acid.

Cross-examined by Mr. Horridge: Vicarey, in his specification, said that the maximum percentage of iron in the acid to be safe was ·0025 gramme per 100 grammes of acid. The plaintiff company was organised about one year ago last September. Its business was the manufacture of accumulators. The accumulators for the Admiralty were used for wireless telegraphy. They made their own plates, which were placed in sulphuric acid. They used nothing to cause rapid oxidising. If there were impurities in the plate itself it would cause trouble. If plates were overformed it would cause trouble. Mr. Kershaw told him that the acid was practically free from iron. The sample which was tested in March showed iron one part in one million parts. They began to use the acid on April 3rd, and it was not until May 2nd or 3rd that they found it was wrong. They did not find it out until they had tested the batteries. He was not at all surprised to hear that several firms had used this acid with satisfactory results, considering the kind of batteries some turned out. Their batteries were very superior batteries.

Mr. West, a chemist in the plaintiffs' employ, gave evidence to testing the acid in question and finding more iron in it than the sample contained. He heard Mr. Kershaw say that the proper acid had not been sent.

Mr. Cannon, analytical chemist, also gave evidence as to the amount of iron in the acid in support of the plaintiffs' case.

At the close of the plaintiffs' case, Mr. Roche said that all the defendants guaranteed was that the acid sold should be safe in accumulators. The sample was taken to show the plaintiffs that the acid was free from an excessive amount of iron, and that it was fit for use in accumulators.

Mr. Kershaw, examined, said he was secretary of the defendant company, and he told Mr. Opperman that "B.A.A." acid was the best, and that they tested it by Vicarey's specification. He never told him there was no iron in it, or that it was absolutely pure—pure acid would cost from £15 to £20 a ton, against about £5 10s. When he saw Mr. Opperman on May 8th, he tested the acid and found it was the same colour as the sample he had tested in March. He never said anything about having delivered the wrong stuff.

Cross-examined: The persons who had stated that he had said that the wrong acid had been sent, had told a deliberate lie.

Mr. Hammond, analytical chemist, said that "B.A.A." acid was manufactured from the best Sicilian brimstone, and was worked from Vicarey's specification. He had tested the acid in question and found it satisfactory.

Mr. G. W. Pritchett, of the firm of Pritchetts & Gold, Ltd., manufacturers of accumulators, said they used the defendants' acid and had always found it satisfactory.

Mr. William Peto, of Messrs. Peto & Co., and Mr. William Pearson, of Messrs. Pearson & Co., corroborated the evidence of Mr. Pritchett.

In the result, his Lordship, in giving judgment, said he was quite clear that the acid delivered was not as good as the sample, and that it was a sale by sample. He thought the bulk of the acid supplied to the plaintiffs did not in all material respects agree with the sample, and that it contained a substantially greater quantity of iron. He accordingly entered judgment for the plaintiffs, the damages to be assessed by an official or special referee, or as the parties might determine.

An Interesting Canadian Case.

Recently in the Supreme Court, Ottawa, the hearing of the appeal in the case of the Guardian Fire and Life Assurance Co. *v.* the Quebec Railway, Light and Power Co., was taken up. The respondents, plaintiffs, supply electric lighting in the City of Quebec, and on October 18th, 1903, a house on their circuit in Crown Street, insured for $2,700 by the appellants, was destroyed by fire, alleged to have been caused through a defective transformer breaking down and sending a current at 2,000 volts over the secondary wires, in the buildings, which were designed to stand 110 volts only. The insurance company, after paying the amount of the insurance, obtained a subrogation from the proprietor of the house, and took action against the electric company, claiming reimbursement on the ground of negligence in failing to maintain the transformer in a proper condition to ensure safety from the dangerous high-currents on the primary wires. The defendants pleaded that their appliances were of the best quality and skilfully set up; that the fire was not caused by electricity, or, if it were so caused, it resulted from improper wiring in the house by unskilled persons, and not according to regulations. At the trial, Mr. Justice Andrews found that the fire was caused by electricity, but that no fault or negligence had been proved against the electric company, and the action was dismissed. This judgment was reversed by the Court of Review, composed of Justices Routhier and Langelier and Pelletier, but the Court of King's Bench, on appeal, restored the Trial Court judgment, Mr. Justice Lavergne dissenting, thus leaving a division of five judges against, and four for plaintiffs' contentions. By the present appeal the plaintiffs seek to have the judgment of the Court of Review restored.

REVIEWS.

The Management of Electrical Machinery. By F. B. Crocker and S. S. Wheeler. London: E. and F. N. Spon, Ltd. 1906. Price 4s. 6d. net.

The purpose of this little book as set forth in the introduction, is to bring forward the more important facts which present themselves in the actual handling of generators and motors. The book is in reality a very practical treatise on the above, and bothers the mind of the reader with very little mathematics; if a stray symbol does creep in, it is simply a formula taken out of the "Engineer's Pocket Book."

The volume is divided into five parts, and the authors have taken care that the different subjects are treated separately and in the proper order, and that the headings are printed in heavy type to facilitate ready reference to any sub-division. Chapters I and II deal with definitions and such things as weight, handling, interchangeability, cost, &c. A point set forth is that the efficiency of a generator at maximum load is not so important as at average load.

Chapter III is, in our estimation, the most important in the whole book. Hitherto most treatises on electrical machines have left the mechanical engineering part severely alone, and as the mechanical part is bound up indissolubly with the electrical, there has always been a void very apparent to those who have to do with the practical management of machines. Chapter III starts off with a discussion on foundations and on the fixing of a machine in position. Good perspective drawings accompany the text, making the instructions plain to the non-technical man. Methods of driving are then taken in hand, and the advantages and disadvantages of direct, belt, rope and geared drives are set forth in full. The illustrations of water turbine drives are very good; in our experience this class of drawing is usually of a most highly complicated character, and it is pleasant to observe here that unimportant details are subservient to the main scheme.

Among the advantages claimed for the rope drive is that of cheapness; this, at any rate, is not our experience of grooved pulleys. Under shafting we are told that cold rolled shafting has a smooth hard surface, and that it is difficult to make it perfectly straight; it might also have been mentioned that it is difficult to make the cross-section circular.

Chapter IV deals with methods of wiring. It must be remembered, however, that the International Ohm is used in the calculations. In fact, it must never be forgotten that this book was written in America by Americans, and that allowance must be made for customs peculiar to that country.

Chapters V and VI deal with the operation of generators and motors, and there are many plain and useful diagrams connected therewith.

Part II is headed "Testing and Inspecting," and the first chapter is sub-headed "Adjustment, Friction, Balance, Noise, Heating, Sparking." Then follow chapters on resistance, voltage and current, speed and torque, power and efficiency, all treated in an easy way.

Part III is on "Localisation and Remedy of Trouble." The authors succinctly state that all the ills that generators and motors are heir to, fall into the following list:—(1) Sparking at commutator; (2) Heating of commutator and brushes; (3) Heating of armature; (4) Heating of field magnets; (5) Heating of bearings; (6) Noisy operation; (7) Speed not right; (8) Motor stops or fails to start; (9) Dynamo fails to generate; (10) Voltage not right.

We may add that we have seen nearly the whole of these little troubles present at once on an American motor; but it was, perhaps, the exception we had to deal with.

Remedies are given for the correction of each abnormal symptom. The ever-green question of sparking at the commutator appropriates a chapter to itself.

Part IV is on "Arc (constant current) Dynamos." It is a little startling to learn that for a certain well-known machine of this class, there are no fewer than 36 symptoms of illness, with the attendant remedies.

Part V deals with the management of railway motors.

Altogether there are 218 pages and 131 illustrations. The size is handy for slipping into the pocket.

Practical men, who have little time for the theoretical aspect of the subject, but who still require to know a little more of the ins and outs of the science than is given in the ordinary pocket-books, will find the volume useful.

A Manual of Hydraulics. By R. Busquet. Translated by A. H. Peake, M.A. London: Edward Arnold. 1906. Price 7s. 6d.

This book was prompted probably by the great development of water-power in the Alpine districts, not far removed from the author's own city of Lyons, and it deals with prime movers which employ the energy of moving water for their effects. It is, therefore, a treatise on hydraulics, with a particular application to water-power, and very properly includes the discussion of the fundamental laws of hydraulics, the flow of water through orifices and channels, and the effects of enlargements and contractions, the losses due to these and to friction, and the pressure exerted by fluids in motion.

These preliminary matters occupy the first three chapters, or one-third of the book, the other two-thirds being occupied with hydraulic engines, water-wheels, turbines and constructional work. Here we find the various hydraulic motors classified and types described, beginning with some of the old wheels of the overshot, breast, undershot and half or low breast variety, as well as with mere float wheels, which cannot have a theoretical efficiency of over 50 per cent. of the energy of the water which runs against them, and actually must have much less.

We suppose that water-wheels are still made for low falls where cheapness is a consideration, for such wheels can be put together of timber by a carpenter, and will do very good work and give a good efficiency. Indeed, the efficiency is only so far short of 100 per cent. as may be determined by the friction and by the necessary drop into the tail-race. We are, however, never likely to see a repetition of such structures as the great 70-ft. wheel at Laxey, in the Isle of Man, which has now been replaced by a little turbine, or even of the 56-ft. wheel, which few people have ever seen, boxed up as it was out of public view in the great wheel chamber at the end of a woollen mill on the moor side above Rochdale. There were only a few years ago many of these old wheels, some of great breadth, under the Lancashire mills, and one known to the reviewer was coupled up to a steam engine, as many others were, but this particular wheel had no slip coupling, so that the engine could not run away from the wheel. Great was the owner's talk of how much coal he saved by the help of the water-wheel, until one day repairs were needed, and the engine did all the work with less coal than before. It had been driving the wheel for years. No doubt these old-time wheels may still be found in parts of the country.

But where capital is available even for low falls, the turbine is more efficient to-day, and the pumps at the Windsor Water Works are worked by horizontal turbines with only a few feet of fall. To such and similar turbines about a third of the book is devoted, and we find described the outward flow or Fourneyron turbine, which is practically the earliest of the modern turbines, with the modification suggested later by another Frenchman, Girard. The use of the air-bell or hydro-pneumatisation is dealt with, and generally the methods of calculating dimensions and proportions. Then we find the inward flow wheel, but, curiously, we find no reference whatever to that special and excellent variety, the vortex wheel, now made by Gilbert Gilkes & Co., of Kendal. The inward flow wheel here illustrated is that with numerous fixed guide blades suitable for shutter regulation, whereas the guides of the vortex wheel are few in number and are movable on pivots placed near their delivering ends.

The parallel flow turbine is next dealt with, a wheel which when of reasonable diameter appears well calculated to give good results, and to be suitable for use with deep wheel pits and vertical shaft dynamo machines.

Reference is made to the small diameter American turbines of which such great efficiencies are recorded, but the author has nothing to say on this much disputed point, though we believe that very little reliance can be placed on the very high efficiency claims, for wheels are not tested under proper conditions in the testing flumes. But the American wheels are cheap and do very well in a country where the supply of water is often so much greater than the need that economy of water is a secondary matter.

One of the American wheels, the Leffel, is referred to as having pivoted guide blades; these are really modifications of the vortex wheel guides of which the author appears unaware.

In the Pelton wheel America really possesses an excellent and most efficient agent for utilising high falls; but the Pelton wheel is, we believe, but a follower some years behind time of the Cheetham turbine—an English impulse free-wheel with parabolic cup buckets. Finally, the hydraulic ram is described, and a last chapter deals with dams and structural work, estimation of available fall and calculation of canal sections.

The whole forms a very useful book, which would have been none the worse for an index. There is, however, an excellent table of contents, and the book is one that any engineer engaged on water power should possess.

BUSINESS NOTES.

A Fire and After.—Mr. W. W. Eaton has had his electrical works and stock at Paul Street, Cork, destroyed by fire, and he asks us to request firms with whom he has had dealings to forward him copies of their catalogues and lists.

International Competition in Italy.—The question of adopting electric traction on the State Railways in Italy continues to attract attention, and this is specially the case in regard to international rivalry in respect of the contracts for the execution of the work. In this connection it is announced from Milan that the general administration of the State Railways have decided to introduce electric locomotion in the larger tunnels, as it is expected that this will enable double the amount of traffic to be handled as compared with the working of the trains by steam locomotives. The contract for the conversion of the Giovi Tunnel section on the Milan-Genoa line is reported to have been given to the American Westinghouse Co., the length of the section being 5·58 miles, and the expenditure estimated at £240,000. The firm of Ganz & Co., of Buda-Pesth, has been given the order for the transformation to electric traction of the railway in the tunnel through the Appennines between Savona and St. Guiseppe. It appears that other firms who competed for both these contracts were Brown, Boveri & Co., the Thomson-Houston Co., and the Lahmeyer Co. The technical departments of the State Railways are making preliminary studies for the introduction of electric locomotion on the lines Turin-Modane and Pistoia-Poretta on the Bologna-Florence route, and it is expected that the work will shortly be thrown open to competition.

Exhibition.—A Trades Exhibition was held in the West Ham Town Hall, at Stratford, from November 19th to November 23rd. It was promoted by a local advertising contractor and a number of local tradesmen, together with the Corporation Electricity Department and the local gas company, and made a very creditable show of its kind. A particular feature was the application of electricity to the various exhibits. The Electric Laundry Co. had their stand fitted up as an "electric ironing department," where electric flat-irons were used, and the machinery driven by a 4-h.p. two-phase motor. Another exhibit comprised an electric oven, hot plates, &c., shown by a local baker. The Corporation Electricity Department and the Vulcan Electric Co. both had good shows of electric fittings, motors, &c., and the Harper Electric Piano Co. exhibited one of their pianos. We noticed on the gas company's stand some gas "switches;" they were to all outside appearances exactly similar to an ordinary tumbler switch. They are described as pneumatic. A small copper tube is run from the switch in wood casing almost identical with that used for electric wiring, and near the by-pass burner, a valve is placed which opens or closes the main gas supply. This valve is operated by a dash-pot action in the switch. This simple invention, we are told, has been brought into the market to facilitate the turning up and down of gas at a distance by means of air pressure only, thus giving "the same convenience as afforded by the electric light." Another device that our competitors have endeavoured to copy is a gas flashing advertising sign, but the apparatus on show at Stratford was a very feeble affair and not worth considering as a competitor. The bellows operating it were by no means gas tight. We are glad to hear that in the electricity department rapid progress is being made in connecting up consumers for power. The department had a good show of cooking and heating apparatus on its stand, and it goes without saying that everything in reason should be done to develop this class of business.

Copper in Canada.—An extensive deposit of copper has been found in New Ontario, about four miles from Lorder Lake, which is at the north of Lake Temiskaming. An English syndicate is said to be interested in the property.

An Aerial Prize.—The Adams Manufacturing Co., of London and Bedford, offer a prize of £2,000 to the person who shall succeed in flying from London to Manchester in one day, with two stoppages *en route* to pick up petrol—provided the flight be accomplished with a British-made flying machine propelled by a British-built Antoinette motor.

Teddington Electrical Exhibition.—This Exhibition, to which we recently made brief reference, was opened on October 30th and closed on the 17th inst.; the original intention was to have closed on the 10th inst. The Exhibition was opened by Mr. J. Doherty, chairman of the Teddington District Council, and during the run over 12,000 people visited the show. Very satisfactory business was transacted, and it is expected that the Exhibition will have a good effect on the electrical industry in the district. The main object was to make the exhibition as comprehensive as possible, and a large variety of apparatus interesting to householders and shopkeepers was shown. The following firms were among those represented:—Messrs. Veritys, Ltd., fittings, heating apparatus, motors, &c.; Electromotors, Ltd., knife-cleaners, motors, &c.; Messrs. Sax & Co., Ltd., fittings, radiators, &c.; Union Electric Co., Ltd., Excello arcs, &c.; Messrs. Venner & Co., time switches &c.; The Electrical Co., Ltd., fittings; Edison & Swan Co., Ltd., fittings, heating apparatus, &c.; Drake & Gorham, Ltd., arc lamps, &c.; The Harper Electric Piano Co., Ltd.; Armorduct Manufacturing Co., Ltd., fittings, drills, &c.; and Messrs. Siemens Bros., Ltd., drills. Other exhibits included Nernst lamps, motor-driven sewing machines, boot polishers, &c. A great feature was made by Messrs. Langston-Jones & Co., who ran the Exhibition, of Messrs. Siemens's tantalum lamps, and the new holophane shades, and Messrs. Calmont's flashing signs were well represented. Everything at the Exhibition in the shape of heating apparatus was so marked as to show at a glance what it cost to use, and a very large quantity of pamphlets describing and illustrating electricity in the simplest terms were distributed, dealing with the use of the current for all purposes. The success of the show was largely due to the various firms who lent apparatus for the Exhibition, and also to Mr. C. E. Hume, chief engineer to the Twickenham and Teddington Electric Supply Co., who lent considerable assistance.

Catalogues and Lists.—Mr. Hilliard Stephens, 39, Victoria Street, S.W.—Revised catalogue (No. 30) of the Falkirk Iron Co.'s electrical castings. This is a fine production of some 50 sheets (art paper) of such a size (11 in. × 17 in.) as to render it possible to well illustrate the various designs of electric lamp pillars, standards and brackets, also tramway bases, electric wiring troughs, pavement and roadway frames and covers, &c., which are supplied from the Falkirk works. We need say little about the designs themselves, except that they are well shown, with dimensions stated, and should be of considerable use to electrical engineers who are needing castings for practically any kind of work. Any of our readers who may be specially interested can obtain a copy of the catalogue by dropping a postcard to Mr. Stephens at the address given.

The Armorduct Manufacturing Co., Ltd., has issued an interesting folding card, showing diagrammatically "Seven years progress in the sale of Armorduct wires and cables."

Messrs. Thomas L. Scott & Co., 3, London Wall Buildings, E.C.—Small 12-page list entitled "Practical Talk about Grinding Machines," describing their own grinding wheels, which are made of alundum, the principal raw material used in the production of which is bauxite.

The "Atlas" Carbon and Battery Co., Ltd., Ewer Street, S.E.—A number of circulars, giving information concerning the following:—The "Atlas" automatic accumulators, "Atlas" flame carbons, the W.O. cell and "Dania" dry cells.

The A.E.G. English Manufacturing Co., Ltd., London, W.C.—16-pp. pamphlet describing, showing and pricing their Holophane globes for Nernst lamps; also a list showing types of these lamps for outdoor use.

A "handy" folding card gives a few facts for the benefit of the consumer, relating to the Cryselco lamps made at Kempston Works, Bedford.

Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Catalogue (the Blue Book) of some 50 pages—the Simplex Screwed Price List, 1907-8—wherein are given prices and particulars of all their conduits and fittings for a complete installation, using a screwed form of junction.

The *Brush Budget* for November is worth perusing, if only for the attractive "feature" on its front cover. Attractions of other kinds are found within. Chatty comments and neat illustrations bring the reader closely into touch with the rolling stock, cotton-spinning installation, turbine, motor and other manufactures of the Brush Electrical Engineering Co., Ltd.

Edison & Swan United Electric Light Co., Ltd., London, E.C.—The new edition of Section VIII, Part 3, of the company's standard catalogue is just to hand. It deals exclusively with electric heating. For the interest of electrical contractors and architects tables of cost are given, with a view to showing the advantages of electric heating. The list contains new types and designs, and the prices have received considerable revision and modification. The Ediswan type of radiator is the well-known luminous one. Radiators are illustrated suitable for drawing-room, bedroom and the like service, being finished in every conceivable type and design. An exquisite example is shown in the "Adam" style. The Ediswan radiators are fitted with "Royal Ediswan" lamps, and the extreme portability of the various types is claimed as a feature. The average radiator is quite sufficient for heating rooms of 12 ft. sq. and the ordinary height, and where rooms are larger two or more radiators may be installed, or the company can supply larger radiators for more powerful heaters. The portability of electric radiators admits of their being carried from room to room wherever a plug attachment exists for the purposes of connecting to the mains. These catalogues are being very widely distributed, but a postcard to 36-37, Queen Street, will procure one for any Electrical Review reader not already supplied.

Messrs. Ernest F. Moy, Ltd., London, N.W.—List No. 14, briefly describing, illustrating and tabulating prices of measuring instruments (vertical edgewise type) for continuous current.

Messrs. Veritys, Ltd., Manchester.—Publication No. 545, describing the Pritchetts & Gold accumulators, for which they are agents. These cells are being adopted on the Verity-Dalziell train lighting system.

Messrs. D. H. Bonnella & Son, Ltd., 58 and 60, Mortimer Street, W.—Circular describing Cooper's patent illuminating table cloth and table decorations, and giving illustrations and prices of accessories for use in connection with same.

Reduction of Capital.—In the Chancery Division on 27th inst., Mr. Justice Warrington sanctioned a petition of the South American Light and Power Co. to reduce its share capital from £100,000 to £50,000.

Stolen Wire.—At the Central Criminal Court last week Alfred Sait, 46, Henry John Tipton, 19, and Arthur Pennell, 26, were indicted for stealing and receiving 123 lb. of copper wire, the property of the Postmaster-General. Tipton was sentenced by the Recorder to 12 months, Pennell to 20 months, and Sait to 18 months, all with hard labour.

Dissolutions and Liquidations.—The partnership hitherto existing under the style of KELLY & HIDE has been dissolved. The business in future will be continued by Mr. A. Kelly. Mr. W. J. Hide will continue in practice as a consulting engineer at 42, Produce Exchange Buildings, Liverpool.

PUNJAUB ELECTRIC TRACTION CO., LTD.—This company is winding-up voluntarily with Mr. F. B. Fuller, 13, St. Helen's Place, E.C., as liquidator.

LONDON ELECTRICAL SYNDICATE, LTD.—Creditors must send particulars of their debts, &c., to the liquidator (Mr. W. R. Gaff, 53, New Broad Street, E.C.), by December 31st.

PERFECTA SEAMLESS STEEL TUBE CO., LTD.—A meeting is be held at 131, Edmund Street, Birmingham, on December 28th, to hear an account of the winding-up from Mr. R. A. FENTON, the liquidator. (This must not be confused with the Perfecta Seamless Steel Tube and Conduit Co., Ltd.)

FOREIGN ELECTRICAL BLEACHING PATENTS, LTD. — Creditors must send particulars of their debts, &c., to MR. W. Nicholson, 12, Wood Street, E.C., the liquidator, by December 31st.

OLDSMOBILE CO. OF GREAT BRITAIN, LTD.—A meeting is to be held at 19-21, Heddon Street, E.C., on January 2nd, to hear an account of the winding-up from Mr. J. Carroll, the liquidator.

Book Notices. — *History of Automatic Electric and Electrically-Controlled Fluid Pressure Signal Systems for Railroads.* By William Robinson, New York. Published by the author.—This book is published by the author with a view to substantiating his claim to be the sole and original "inventor of the automatic systems now in general use on the leading railways in the United States and foreign countries," and is levelled mainly against certain well-known companies, which are accused by him of having deliberately robbed him of his rights.

"Proceedings of the American Academy of Arts and Sciences." Vol. XLI, No. 24, and Vol. XLII, Nos. 4, 8 and 9. Papers by B. O. Peirce.

"Laboratory Work in Electrical Engineering" (Preliminary Grade). By J. Roberts, junr. London: Harper & Bros. 1906. 5s. net.

"Journal of the Western Society of Engineers." Vol. XI, No. 5, October, 1906. Chicago: The Society. 50 c.

"Proceedings of the American Society of Mechanical Engineers." Vol. 28, No. 8, November, 1906. Baltimore, Ind., The Society.

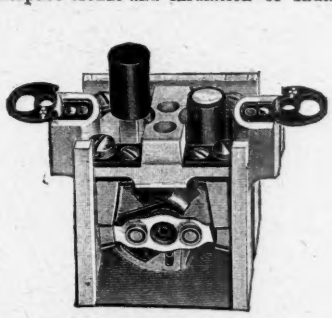
"Journal of the Franklin Institute." Vol. CLXII, No. 5, November, 1906. Philadelphia, Pa.: The Institute. 50 c.

"Schalttafelbau." By A. Boje. Hanover: Dr. Max Jänecke. M. 2.80.

"Alternating Current Motors." By A. S. McAllister. New York: McGraw Publishing Co. $3.00.

"Science Abstracts." Sections A and B. Vol. IX, No. 107, November 26th, 1906. London: E. & F. N. Spon, Ltd. 1s. 6d. net, each section.

New Push-Button Switch.—The HART MANUFACTURING CO., of 25, Victoria Street, S.W., have recently placed a new push button switch on the market. It is claimed to have an exceptionally rapid action; in the single-pole switch there is a double break, and in the double-pole a quadruple break. The mechanism is of case hardened and tempered steel, with contacts of genuine phosphor bronze and insulation of India sheet mica.



NEW PUSH-BUTTON SWITCH.

In addition, the base is made of vitrified porcelain, which is moisture proof, and much smaller in diameter than the base of the former type of push-button switch, which admits of it being sunk into the wall with less cutting away. This of course is an important feature. We understand that these switches have been recently installed in several fine hotels in Paris.

Card Filing System.—A neat little device has been sent us by Mr. GORDON DUNKERLEY, of 5, Orchard Cottages, Kingston-on-Thames. It consists of a cheap collar stud, with snap head, and a set of card slips, each perforated in three places. Thus the slips can be quickly filed in three sets, and any one of them can be readily consulted by spreading out the cards. Further particulars of this ingenious and useful system, and perforated cards, can be had from the inventor.

Japan.—As we recently mentioned, there is at present a great demand for cables and copper wire in Japan, in consequence of the great developments which are taking place in electrical undertakings. It is announced that the Furukawa Copper Mining Co. are about to erect new works for the manufacture of copper wire, as their present works, which have an output of 1,800 to 2,000 tons per month, are found to be quite insufficient. Manufacturers of cable and wire-making machines ought to find a good market here.

Siemens's Contracts. — Some photographs recently received from SIEMENS BROS.' DYNAMO WORKS, LTD., show considerable activity at the Stafford Works. Among the more important plants now in course of construction and erection are the following:—

Siemens-Ilgner winding plant for Duffryn Rhondda—

One 1,420-B.H.P. winding motor; one variable motor-generator with maximum output of 1,165 KW.; one 740-B.H.P. induction motor for driving the variable voltage generator.

Continuous-Current Generators and Motors.—Plant having an aggregate output of about 20,000 KW., including—

Two 1,500-KW. generators for Royal Arsenal, Woolwich, and generators for the equipment of various works of 750 KW., 660 KW., &c., and large motors in proportion.

Motor-generator plant having an aggregate output of about 12,000 KW., including—

Four 600-KW. motor-generators for Westminster.
Fourteen 500-KW. motor-generators for the L.C.C.
Four 50-KW. motor-generators for the L.C.C.
One 500-KW. motor-generator for the North-Eastern Railway.
One 500-KW. generator for Newcastle.

Alternators having an aggregate output of about 20,000 KW., including—

Four 3,510-KW. alternators for Japan.
Two 750-KW. alternators for Cambrian Collieries.
Two 600-KW. alternators for Coventry.
And several large machines for Australia.

A very large quantity of all sizes of induction motors is going through the shops, and amongst special motors there are several for the North-Eastern Railway, for various collieries and for Japan.

Accumulator Contracts.—THE BRITISH ACCUMULATOR CO., LTD., of Westminster, have received the following orders for batteries:—

110 cells, 500 ampere-hours capacity, for Messrs. Cooper & Co.
55 cells, 420 ampere-hours, for Rugby.
55 cells, 300 ampere-hours, for South Godstone.
55 cells, 360 ampere-hours, for Witley.
55 cells, 180 ampere-hours, for Shiplake.
Also smaller complete lighting sets for Bristol and Stony Stratford.

Trade Announcements.—MESSRS. ARMSTRONG, POWER and Co., of 118-122, Holborn, E.C., have been appointed sole agents for London and export, for the "Cantie" Switch Manufacturing Co., of Nottingham, and they keep a stock of these switches at the above address.

MESSRS. LIND & Co., wholesale electrical suppliers, 60, Castle Street, Liverpool, have recently made alterations in their agency arrangements, and are now sole representatives in that district for Simplex Conduits, Ltd., the Union Electric Co., Ltd., the Wandsworth Electrical Manufacturing Co., Ltd., and the Union Cable Co., Ltd. Agencies for the British Prometheus Co., Ltd., and the Electric and Ordnance Accessories Co., Ltd., have been discontinued, but the goods of these firms will be stocked by them as formerly at their warehouse, 37, Moorfields.

MESSRS. T. HOOD & Co., LTD., inform us that they have now been appointed sole agents for Messrs. Marples, Leach & Co., of London, in the Western Counties and South Wales, and they will be pleased to receive any inquiries for that firm's specialists, including motors, dynamos, and accessories, at their address, 26, Bath Street, Bristol. Messrs. Marples, Leach & Co.'s branch office at Post Office Chambers, Wind Street, Swansea, will be under the personal supervision of Mr. T. Hood.

Mr. P. J. MITCHELL, of 31 and 32, Budge Row, has removed to more commodious offices at Caxton House, Westminster, S.W. His telephone number will be 2,107 Victoria.

THE BLASBERG ENGINEERING CO., of 78, Cross Street, Manchester, have been appointed sole agents in the British Isles and Colonies for the manufacture and sale of water coolers, &c., on the Blasberg patent system, which is already in operation in this country. Although this system has been in use on the Continent only a very short time, plants have been adopted for dealing with water for over 100,000 H.P. The business is under the general management of Mr. C. Bradshaw, who, we understand, has had many years' experience in water-cooling plants for condensing and other purposes. An illustrated four-page circular relating to the Blasberg water-cooling apparatus has been issued.

An amalgamation has taken place between the BIRMINGHAM GUILD OF HANDICRAFT, LTD., and GITTINS, CRAFTSMEN, LTD., who will in future carry on the joint businesses under the name of the former company at 45, Great Charles Street, Birmingham, and at 7, Newman Street, Oxford Street, London, W. The company retains the services of the directors, designers, and principal craftsmen of both the amalgamated firms.

In order better to cope with increased business, Mr. CHARLES PULLAN, electrical engineer and contractor, of Bradford, has re-organised his staff, and has combined the various departments, putting them under one head. The general management is now in the hands of Mr. Harry Moss, with Mr. B. Robinson as foreman of works. Mr. Pullan will continue to give attention to the business.

New Destructor.—The Corporation of Dunoon, on the Clyde, recently placed a contract with the Horsfall Destructor Co., Ltd., for a four-cell destructor, with two boilers; this was completed in four months, under the supervision of the burgh engineer, Mr. James Andrew. The steam generated is used in the gasworks.

Liverpool.—The Northern Electrical and Ventilating Co., of Liverpool, has recently carried out the lighting of the new David Lewis Club, which was opened by the Lord Mayor on Saturday last. The building is lighted throughout with electricity, there being about 1,000 lights installed.

Milan Awards.—The International Jury of the Milan Exposition has just announced the award of a Diploma d'Onore to the "Long Arm" system of electrically-operated bulkhead doors. The "Long Arm" System Co., of Cleveland, Ohio, had an elaborate installation of its water-tight doors at the Exposition, and we are informed that so much attention was attracted by the exhibit as to give rise to a demand upon the Government to make the installation of electrically-operated bulkhead doors on large passenger ships obligatory.

Colliery Motors.—Messrs. Crompton & Co., Ltd., have just received an order from the United National Colliery Co., Ltd., Cardiff, for 13 of their standard three-phase induction motors, 600 volts, 25 cycles, aggregating 230 B.H.P.

Indian Mica Production.—The Geological Survey for India states that there was a considerable rise in the quantity of mica exported during 1905, when the total weight was 133,159 cwts. as against 18,250 cwts. in 1904. The total value, £142,008 against £83,183, did not rise in the same ratio, owing to the very inferior quality of the mica now being obtained from Bengal. The value per cwt. of Madras mica is over £7, as compared with £1 14s. for Bengal mica.

Prices Advance.—Owing to the continued rise in the price of copper and other raw material, Messrs. E. P. Allam and Co. notify an increase of 10 per cent. in their list prices, to take effect on December 1st next. This will apply to the whole of their manufactures consisting of "Premier" motor starting switches, speed regulators, D.P. switches, service boxes, reversing controllers, &c.

Belgium.—The report of La Société Liegoise d'Electricité, of Liége, for the last financial year shows a profit of £10,296.

LIGHTING and POWER NOTES.

Bermuda.—It is stated that Mr. Philip Manson, of New York, has visited the island with the object of forming a company for the supply of electric light and traction in Bermuda. Mr. Manson is prepared to spend $100,000 as soon as formalities can be completed, and represents Mr. Henry P. Neun, of Rochester, N.Y., who is a millionaire.

Bexley.—The U.D.C. has applied to the L.G.B. for a loan of £4,347 for mains, services, &c.

Bray (Wicklow).—At the meeting of the U.D.C. last week, it was proposed that the L.G.B. be asked to sanction a loan of £3,445 to carry out E.L. extensions, as recommended by the electrical engineer, but after considerable discussion, the motion was lost. A motion to apply for a loan of £1,162, in order to carry out part of engineer's recommendations, was carried.

Canada.—New Brunswick.—Some contracts have recently been awarded by the Maine and New Brussels Electrical Power Co. in connection with the water power scheme it is developing at the Aroostock Falls. The turbine plant will be built by the Jenckes Machine Co., of Sherbrooke (Que.), and will consist of two 900-H.P. units, each comprising a pair of special 21-in. Crocker turbines, which will run at 600 R.P.M. with an 80 per cent. efficiency at full power. A steel penstock, 6 ft. 6 in. diameter by 75 ft. long, conveys the water from the forebay to each unit, which will be direct connected to a General Electric generator. The headquarters of the Power Co. are at Presque Isle, Maine.

Montreal.—In consequence of the extraordinary increase in the sale of energy, the Montreal Light, Heat and Power Co. has found it necessary to largely augment its plant, and it has recently contracted with the Canadian Westinghouse Co. for plant for the new power station on the Soulangeo Canal, about 40 miles west of Montreal, on the St. Lawrence. This new machinery consists of three water turbo-driven 750-KW. alternators, generating three-phase current at 4,000 volts. There are also two 150-KW. 125-volt exciter units. An important part of the installation consists of 13 2,500-KW. oil insulated, water-cooled transformers. Seven of these transformers will be used for raising the voltage at the generating station from 4,000 to 44,000 volts, the remaining six being used at the lowering end of the transmission line, stepping down from 44,000 to 12,000 volts. Generators and exciters will be controlled by motor-operated rheostats and the complete switchboard apparatus, which the Canadian Westinghouse Co. is also furnishing for both main and sub-stations. It is anticipated that this new plant will meet the continually increasing demand for electric power in Montreal for some time to come.

Chesham.—The U.D.C. has been advised to agree to the E.L. order being taken over by a local company, provided that the costs of obtaining the order is refunded to the Council, that a substantial deposit is made as a guarantee of the continuation of an efficient supply, and that the Council should be given an option to purchase the undertaking at certain periods.

Continental Notes.—Spain.—La Sociedad Fuerzas Motrices del Sudeste de Francia has submitted a scheme to the municipal authorities of Barcelona, to supply electrical energy from its plant at Puigcerda for power purposes at a very low price.

Hungary.—The Municipality of Mora-Szombat is about to invite tenders for the erection of an electricity works in the town.

Germany.—The plant of the Bielefeld electricity works is to be extended at a cost of £11,000.

The Lighting Question in Paris.—The scheme proposed by the united electric lighting companies in Paris and the Schneider-Mildé Co. for the future supply of Paris has now been placed before the Municipal Council. According to this new combination, all the electric cables will pass into the possession of the Council at the end of 1907, and it is suggested that the cables, together with the municipal "sector" at the market halls, should be leased to the union of the companies (Union des Secteurs) until the end of 1913 and the concessions extended until that time. From that period the lease would pass over to a new concern to be established under the title of the Compagnie Parisienne de Distribution d'Electricité, with a share capital of £2,000,000, which would in the meantime erect two stations of 25,000 KW. or 50,000 KW. capacity in the neighbourhood of Paris. The initial concessions would be prolonged to the end of 1933 in the case of the new company. On the expiration of the concessions, the cables, works and equipment would become the property of the city, which, commencing with 1923, would have an annual right to give notice of intention to take over the whole undertaking two years later, on agreeing to carry out redemption of outstanding capital, together with the payment of a yearly sum. The scheme provides for a reduction in the price of electricity, which at present amounts to 1·50 fr. per KW.-hour as a maximum, to 80 centimes from the year 1908 to the end of 1913 for lighting and to 35 centimes for other purposes, whilst the rates will be 70 centimes and 35 centimes respectively onwards from 1913. In addition to paying rent for the lease of the municipal station at the market halls the combination of lighting companies, which now pay about 1,800,000 fr. annually to the city, offers 5,500,000 fr. per annum to the end of 1913 and 7,500,000 fr. yearly for the subsequent period of the concession.

London.—Camberwell.—The Works and General Purposes Committee has received letters from the B. of T. in regard to the repeated applications of the Council in connection with certain applications by the County of London Electric Supply Co. for the laying of mains. One of the letters is in regard to the desire of the Council to be represented before the auditor appointed by the Board to examine the accounts of the company. In regard to the laying of mains, the B. of T. informs the Council that it is "considering the question of promoting legislation to provide, *inter alia*, for the bringing into an area a supply of electricity generated at a station outside the area. The legislation proposed is general, but at the present time the Board is not able to indicate precisely what form it will take. In regard to the Council being represented before the auditor the B. of T. remarked that no other local authority had made a similar application, and further stated that it is "considering the question of making arrangements for a representative of the Camberwell local authority to have facilities to discuss with the auditors of the accounts of companies having powers in Camberwell any questions which may arise on those accounts; and if satisfactory arrangements cannot be made," it is "prepared to consider the question of making regulations in the matter."

L.C.C.—At Tuesday's meeting of the Council the Finance Committee presented a report dealing with the question of the periods of loans for electric lighting purposes. Sir M. Beachcroft asked whether the Borough Councils had approached the Council on the subject or whether it emanated from the County Council. In reply, Lord Welby stated that the matter was brought forward by the Finance Committee. It was subsequently decided, on the recommendation of the General Purposes Committee, to amend the order of reference to the Finance Committee by the withdrawal of the paragraph relating to the periods of repayment of loans by Borough Councils for electric lighting. This will enable the new arrangement proposed by the Finance Committee to be carried into effect. It appeared from the Committee's report that after the chief engineer had conferred with Sir Alexander Kennedy on the subject, the conclusion had been arrived at that the maximum period for repayment should be as follows:—60 years for freehold land, 50 years for buildings, 30 years for mains, 20 years for plant, 12 years for house connections and 10 years for meters. In the future the Finance Committee stated that it proposed, when sanctioning loans to Borough Councils, to provide for repayment within the maximum periods mentioned.

Hammersmith.—Complaints have recently been received as to alleged nuisance from smoke, fumes and grit emitted from the electricity works. On the suggestion of the electrical engineer, a separate iron chimney on a concrete foundation and connected to

the present boilers by a cross flue about half way up, is to be erected at a cost of £300. The base of the stack is to form a receptacle for the fine dust, which can be frequently cleaned out from a proper access door.

Battersea.—The B.C. is to take up an L.C.C. loan of £10,763 for electric lighting purposes. £9,563 of this is to be repaid in 20 years, and the remainder in 10 years.

Southwark.—Mr. Carson Roberts, when attending the Town Hall to audit the B.C. accounts a few days ago, remarked that it was quite true there was no fund called a depreciation fund in connection with the electricity undertaking, but by the annual prepayments of principal such an undertaking had something which was much bigger, for the sinking fund was a depreciation fund, plus something else. The attitude of Councillor Somerville, who has repeatedly brought forward the question of providing a depreciation fund, was characterised by Mr. Roberts as being perfectly absurd. We should say that Mr. Roberts's idea of a sinking fund constituting a provision for depreciation is equally absurd.

Lytham.—A local company has been formed to take over the Lytham E.L. order.

Manchester.—The Manchester Ratepayers' Association has decided that it cannot undertake the responsibility of further opposing the borrowing powers which the Corporation is seeking from the B. of T., with a view to extensions at the Stuart Street Electricity Works. Some leading members of the Association, accompanied by an electrical adviser, recently waited upon the Electricity Committee, and in company with the Committee's chief engineer (Mr. S. L. Pearse) made an inspection of the various stations and made full inquiry as to the extensions and the necessity for them. After careful consideration of what they saw and heard—and acting on the advice of the expert who accompanied them—they decided to withdraw their opposition.

Mexico.—A central electricity works has just been put into operation in the town of Tepic.

Mountain Ash.—A member of the U.D.C. has given notice to rescind the decision adopting an E.L. scheme submitted by Mr. Day, electrical engineer, the reason given being that it cannot be carried out for the sum estimated—£4,630.

New Zealand.—Auckland.—At a City Council meeting recently, Mr. W. G. T. Goodman, the Council's consulting electrical engineer, advised that tenders might be invited for the supply of electrical plant up to February 7th. The Mayor stated that the question of appointing an electrical engineer had been deferred until the acceptance of a tender for the plant. Mr. Goodman also recommended that the maximum demand system be adopted; that the rate for lighting be 7d. per unit for first hour per day, and 2d after, and for motive power 3d. per unit for first two hours per day and 2d. per unit after. This was agreed to.

It has been decided to accept the tender of Messrs. Philcox and Son at £5,380 for the erection of the Council's proposed electric power station, provided the firm agrees to reduce it by £800 if certain alterations are made in the building.

The taking over of the refuse destructor from the contractors has been in abeyance for some time owing to the contract test not being satisfied, but recently the Council decided to pay the outstanding balance of £11,533 due, and to take over the undertaking.

Wellington.—Negotiations have been proceeding between the City Council and the Electric Light and Power Syndicate, in regard to the sale of the company's undertaking to the Council or for an arrangement whereby the charges to consumers will be reduced.

Ogmore and Garw.—The U.D.C. has decided to promote a Bill in Parliament to acquire the undertaking of the Ogmore Valley E.L. and Power Co.

Portsmouth.—A L.G.B. inquiry was held on November 21st into the application of the T.C. for a loan of £1,490 for the provision of a circulating pump, a spare rotor and underground tanks in connection with the E.L. undertaking. There was no opposition.

South Africa.—Johannesburg.—A Natal correspondent says that at a Town Council meeting held October 30th it was resolved to confirm a provisional agreement entered into between the Traction and Lighting Committee and the consulting engineers on the one side, and Messrs. Stewart & Co., the contractors for the plant, on the other. As the result of this agreement, which only now requires the approval of Messrs. Stewart and Co.'s sureties, the Council surrenders all claims against the contractors in respect of their failure to complete the work within the contract time; on the other hand, the contractors abandon all claims for damages to which they might be found entitled under the contract. The chief feature of the agreement is that Messrs. Stewart & Co. take over the power station and staff for a period of 12 months, or until 10,000,000 units have been generated, and supply the municipality with energy at a cost of 1·1d. per unit, plus £1,000 per month. Under existing conditions the cost per unit is 2·5d., so that the municipality effects a saving of over 1d. per unit, without incurring any further risk.

Messrs. Stewart & Co. mention in their report that the work done on unexpected extras on the plant, &c., has involved a loss of about £16,000. By the conditions of the contract Messrs. Stewart & Co.'s claim would amount to at least £20,000, while the Council's counter claim would be £37,555, and, seeing that arbitration costs would be a heavy item if the case was put to the test, it was felt the wisest plan would be to accept the terms.

Durban.—For the quarter ending October 31st, the borough electrical engineer's report states that 4,362 lamps were applied for, making the total number to date 152,196; 95 applications were received for current, and 91 new connections made. The number of units consumed for private lighting was 450,419; 10 new connections were made for power purposes, the number of units consumed being 279,159. Nine extra incandescent lamps for street lighting have been added, making the total number to date 1,399. The erection of the ash handling plant at the power station is about complete. The work of changing over the Berea distribution to the three-wire system with 400 volts across the outers is still being carried out.

Southport.—Owing, it is stated, to the extra price paid for coal and heavy maintenance charges, the net loss on the half-year's working of the Corporation's electric undertaking, is £2,200, against a loss of £1,591 last year. It is some consolation, however, to learn that the tramways undertaking has earned a net profit for the past seven months' working of £1,173, against £174 in 1905. Receipts per car-mile increased from 10·03d. to 10·93d.

Tynemouth.—The T.C. has decided to supply energy to the North and South Shields Electric Railway Co., at 1·5d. per unit for the first 400,000 units, 1·4d. for the next 200,000, and 1·3d. beyond.

Warmley.—The B. of T. has written to the U.D.C., asking what steps it intends to take for carrying out the E.L. order granted in 1903. The Council on November 20th decided to ask for another year's extension, as negotiations were proceeding with the Somerset Power Co.

West Ham.—The electrical engineer reports that practically the whole of the power districts are now being supplied with two-phase energy. There is now 250 H.P. in motors on consumers' premises, being connected up and fixed, and orders are in hand for a total of 1,500 H.P., and inquiries are continually being received apart from canvassing. There is a very considerable increase in lighting also, especially in the direction of flame arc lamps.

Willesden.—Questions have arisen in connection with a claim to be made by the Council against the North Metropolitan Electric Power Supply Co. The agreement, of February, 1904, between the Council and the company, provides that any excess of expenditure over income for a period of three years from June, 1903, shall be borne by the company, the amount, however, being limited to £4,894. The Finance Committee has decided for the period in question to include not the actual payments for instalments and interest, but the interest accrued day by day with a proportionate part of the repayments of capital to the date of closing each year's account, although falling due for payment thereafter. Upon this basis the amount due from the company is £1,848. In regard to the audit of the electricity accounts for the year ending March 31st last, objection was taken, at the audit, to an expenditure of £3,300 incurred in the purchase of sites for a new generating and sub-station. The objector contended that this amount of £3,300 being part of the capital sum received on the sale of the undertaking to the North Metropolitan Co. could only be applied in accordance with the provisions of the Willesden E.L. Order, 1898. Upon examination the auditor found that this contention was correct, and has accordingly disallowed the expenditure on capital account, and transferred it to revenue upon which account the expenditure is perfectly legal. The auditor informed the Council that the treasurer's account at the close of the year was overdrawn £1,748 odd, and points out that it is desirable that this overdraft should be substantially reduced as speedily as possible. The result of the disallowance of £3,300 will be to increase the overdraft to £5,048 9s. 11d. The Council has resolved to apply to the L.G.B. to reverse the decision of the auditor so that the cost of the sites acquired may not be debited to the revenue account, but to the suspense account of £3,300, or in the alternative, that the Board sanctions a loan for the purchase money, which can first be borrowed, and at once repaid as capital out of the suspense account. With regard to the overdraft, the account was in credit on the following day.

Wood Green.—A year or two ago the Council sought the sanction of the L.G.B. in respect of a loan of £50,000 for E.L. purposes, but the application was refused. On Friday last, Mr. Walter Young, the L.G.B. auditor for the district, attended at the Town Hall to answer questions and objections raised at the opening of the audit a fortnight previously. Mr. Young stated that objection had been taken to the action of the District Council in appointing a man to canvass the district on the electric lighting question. He had carefully considered the matter, and he was not aware of any authority by which that payment could be sanctioned. The clerk to the Council intimated that he understood that a canvass was made because the Inspector was anxious to know what the feeling of the district was. It was stated that the Board's Inspector expressed no anxiety; and the auditor pointed out that the canvass took place after the Board had refused the application, and he did not think that the payment for such canvass was legal. He would report to the L.G.B., and probably it would be disallowed and surcharged.

TRAMWAY and RAILWAY NOTES.

Bath.—One of the Bath Electric Tramways Co.'s cars on Sunday last, ran backwards down a hill. It is stated that the motorman left the front platform to apply the brakes from the rear end of the car, but before he could do so the car left the rails and fell over. None of the five passengers in the car sustained serious injury, but the motorman was pinned beneath, and was removed to hospital suffering from internal and other serious njuries.

Barton (Lancs.).—The R.D.C. has agreed to lease the powers under the Clifton Light Railway Order to the Lancashire Electric Tramways Co.

Belfast.—It is understood that the British Electric Traction Co., which controls the Cavehill and Whitewell tramway north of the city, is seeking parliamentary powers to run over the corporation's system as far as Castle Junction, in the centre of the city. It would be of interest to learn if this has any connection with the proposed tramways from Newtonards to the Knock terminus of the corporation's system, and from Bangor and Holywood to the city suburbs.

Canada.—Toronto.—The question of the damage done to the water mains by electrolysis is engaging the attention of the Toronto City engineer. The Toronto Electric Railway Co. has been threatened with legal proceedings, but the municipality would rather the company take preventative measures for the future than that the matter should go to the courts. The City engineer recommends that the company adopt a double trolley wire. In Montreal the Street Railway Co. is laying a wire between the tracks touching the rails at stated points for the purpose.

Hamilton.—The tramway men are out on strike, and at the end of last week rioting broke out and became so serious that troops were called up from Toronto and London to patrol the streets in which the tramways company has endeavoured to continue a service.

The *Financial News* says the Grand Trunk Railway is about to build a double electric line between Port Huron and Detroit during the coming year.

Continental Notes.—Holland.—Great activity prevails at the present moment in Holland with regard to electric railway and tramway construction and the extension of light railways in general. The fact that the import duties into Holland are practically *nil* and that the freight from England is considerably less than that of the railway carriage which has to be paid by firms in competing European countries, is hardly appreciated by British manufacturers when business in Holland might be obtained by them. Another factor which is often overlooked is that the Dutch concerns are either owned by the Government or heavily subsidised, and that consequently the material is allowed to enter the country free of all Customs buty. Engineers with a limited knowledge of French often find good berths on these lines.

One of the largest schemes which has been arranged, and for which plans have been prepared and adopted, concerns the province of Utrecht. It is to be completed by July 1st, 1909. A network of electric railways will be constructed by the Holland Electric Railway Co., of Amsterdam (Compagnie Hollandaise des Chemins de Fer Electriques). The whole province will be covered with electric railways, all of which will lead direct to Amsterdam. The carriage of goods to and from the port will be made a special feature. It is proposed that the Government will give either as subsidy or as a long loan without interest, a sum of £215,000. The municipalities and some large industrial firms in the province will subscribe on similar terms £10,500, and a sum of £16,500 has already been voted for the same purpose by the Provincial Government. A number of other electric railway and tramway projects are springing up all over the country.

A trial survey has been made for an electric railway between The Hague and Vorrburg. An electrical engineer, resident at Arnheim, is in communication with the Municipal Council with a view to obtaining the concession.

Plans are being prepared in respect of a projected electric railway between Nymegen and Emmerich.

Italy.—Another strike of the employés of the tramways has taken place, causing much inconvenience to the public.

Halifax.—The net profit on the Corporation tramways for the half-year ended September is stated to be £1,648, and the net loss on the electricity undertaking, £1,335. The profit on the tramways is decreased owing to the recent strike, the Tramways Committee computing the total loss at upwards of £3,000.

Largs.—The proposal to construct an electric tramway line between Largs and Wemyss Bay has been dropped.

Leyton.—The U.D.C. electric tramways will be inaugurated to-morrow, the first car leaving the Lea Bridge Road depôt at 2 p.m. All the cars have top covers, which it is anticipated will materially add to their earning power.

London.—G.W. and Metropolitan Railways.—Multiple-unit trains, made up of the new joint stock, have now been put into service between Aldgate and Addison Road.

L.C.C.—The C.C. at Tuesday's meeting postponed the consideration of a report by the Highways Committee, recommending the approval of an estimate of £255,000 for the provision of about 300 additional tramcars for working the tramways, to be completed at an early date, and also for extra services on some of the southern lines.

Middlesex.—It was reported at the monthly meeting of the County Council on November 22nd, that up to date £224,243 had been paid in respect of the purchase of properties required in connection with the light railways authorised by the 1901 order, £304,578 for properties required in connection with the 1903 order, and £1,926 for properties required in connection with the 1906 order. After a long debate the Council rejected a recommendation by the Light Railways and Tramways Committee for the promotion of a Bill in the next Session of Parliament to construct a tramway along Edgware Road from Cricklewood to Netherwood Street or Bridge Terrace. Messrs. Dick, Kerr & Co. have completed their contract for the section of railway No. 15 from Edgware Road to Willesden Green Station at a total cost of £13,413. The estimated cost of the work was £17,000.

New Zealand.—The Minister for Public Works made a statement recently in regard to the development of water-power and its application to railways, but he said the Colony would not launch out on an increased borrowing policy in the immediate future. The application of hydro-electric power for railway working was ever before him, and he had hoped to be in a position to place information before Parliament in the present session, but delays in survey had prevented this.

Wellington.—The City tramways revenue for the first six months of the year amounted to £45,588, which, after providing for interest and sinking fund, leaves a profit of £3,000. It is estimated that the total net profit for the year will be £10,000, which with the amount carried forward from last year, will permit of £15,000 being written off for depreciation and £4,000 being carried forward.

South Africa.—Durban.—The extension of the tramway to Umgeni Village is being proceeded with, there being about 1½ miles of track complete, and it is hoped to open this section early in the year.

Tokio.—The Municipal Assembly met on the 27th inst. to vote on the proposed municipalisation of the Tokio electric tramways. The Municipal Council, which is opposed to municipalisation at the present time, is to reconsider the matter.

Single-Phase in the U.S.A.—According to an article by M. H. Urban in the monthly *Bulletin* of the Société Belge d'Electriciens, the following undertakings are at work in the United States on the single-phase system:—

Westinghouse Co.—Indianapolis and Cincinnati Traction Co.; the first single-phase interurban tramway line, started December, 1904, 90 km. in length. Trolley fed at 3,000 volts, also at 550 volts D.C. in towns; four 75-H.P. motors per car.

New York, New Haven and Hartford; the first single-phase railway, 35 locomotives of 85 tons each, fitted with four 200-H.P. motors, trolley fed at 11,000 volts, also third-rail D.C. in part.

Tunnel of Saint Clair; six locomotives as above, but fitted with three 200-H.P. motors each.

Spokane and Inland; 160 km., trolley line fed at 6,600 volts, and with D.C. in towns. Motor-cars fitted with four 100-H.P. motors each, motor-vans ditto, six locomotives fitted with four 150-H.P. motors each.

Warren and Jameston; gas power station; 60 km., trolley fed at 3,300 volts. Cars fitted with four 50-H.P. motors each, weighing 35 tons and running at a maximum speed of 75 km. per hour.

General Electric Co.—Ballston-Schenectady, August, 1904.

Bloomington, Pontiac and Joliet; 135 km., trolley fed at 3,300 volts, four motors of 75-H.P. each per car. Cost per car-kilometre 5d., including 3·83d. for traction. Cars weigh 30 tons and run at 30 km. per hour. Energy consumed, 1,300 watt-hours per car-km., 41 watt-hours per ton-km. Maximum speed, 66 km. per hour.

Toledo and Chicago Interurban Co.; trolley, 3,300 volts; cars, 35 tons; normal speed, 50 km. per hour; four motors of 75-H.P. each.

West Ham.—The Council have approved plans submitted by the borough engineer for the purposes of the application for a prov. order for proposed tramways in Plaistow Broadway and Greengate Street, Barking Road, and Prince Regent's Lane, to be constructed at an approximate cost of £22,500.

TELEGRAPH and TELEPHONE NOTES.

Bloemfontein.—Experiments are being made in the sending of telephonic messages from Bloemfontein to Johannesburg, over the ordinary telegraph wires. These experiments have so far been successful, and it is anticipated that the public will shortly be able to avail themselves of this means of communication. There is at present practically no inter-town telephonic communication with any part of South Africa.

New Zealand Telephones.—The central battery system is being installed in connection with the telephone exchanges at Invercargill and Timaru.

Overhead Telegraph Wires.—At the resumed hearing of the case, mentioned last week, Mr. Hopkins decided that the proposals of the Post Office to erect overhead wires in Robsart Street, Brixton, were just and reasonable, and gave judgment in their favour, with costs.

The Poulsen System of Wireless Telegraphy.—On Tuesday evening last, at the invitation of Lord Armstrong, a large number of scientific and learned gentlemen witnessed a demonstration of the system of wireless telegraphy developed by Mr. Valdemar Poulsen, of Copenhagen. Sir W. H. Preece presided, and in introducing Mr. Poulsen, gave credit to Mr. Marconi for bringing out a new system of wireless signalling, and to Sir Oliver Lodge for the principle of tuning. The prime object of the Berlin Wireless Telegraph Conference, he said, was to establish a definite wave-length, to be used by all nations in wireless telegraphy. The demonstration that night would sound the death-knell of "spark telegraphy."

Mr. Nevil Maskelyne read the lecture, which in the main followed the same lines as the abstract which we published in our issue of November 16th, p. 776; and Mr. Poulsen, with his assistant, carried out the experiments, many of which were exceedingly striking and beautiful, though their bearing on wireless telegraphy was not very direct. They were, in fact, largely of the Tesla type. An interesting statement was that communication had been effected between Copenhagen and North Shields, a distance of 530 miles, of which 150 are overland, with a mast only 100 ft. high, and a power of about 1 KW. The inventor hopes to obtain trans-Atlantic communication with a power of 10 KW.

The Duke of Argyle moved a vote of thanks to the lecturer, which was seconded by the Danish Ambassador, and carried by acclamation; and Mr. Poulsen briefly thanked the meeting, in English. Sir W. H. Preece moved, and Mr. Gavey seconded, a vote of thanks to Lord Armstrong, who acknowledged it, and the meeting then closed.

St. Lucia.—The Colonial Report for 1905, referring to "Telephones," says that the system now comprises 112½ miles of trunk lines and 53 miles of branch lines—a total of 165½ miles. On December 31st, 1905, there were 111 subscribers. Receipts were £551, or £44 less than in 1904, and the expenditure £1,568, or £1,016 in excess of the revenue. The system will not pay for a long time to come, as rental revenues amount only to about £400 per annum.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Trinidad-Demerara (No. 2.)	Nov. 18, 1906	Nov. 27
Paramaribo-Cayenne	Nov. 27, 1906	..
Cayenne-Pinheiro	Aug. 15, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Dominica-Martinique	May 7, 1902	..
Guadeloupe-Martinique	Aug. 29, 1906	..
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	..
Curacao-Coro	Closed	..
Curacao-La Guayra	Jan. 12, 1906	..
Curacao-Maracaibo	Closed	..
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904	..
Garachico-Santa Cruz	July 12, 1906	..
Las Palmas-Arecife	Aug. 18, 1906	..
Guantanamo-Mole St. Nicholas	Nov. 22, 1906	..
Mole St. Nicholas-Cap Haytien	Nov. 22, 1906	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..

CONTRACTS OPEN and CLOSED.

OPEN.

Accrington.—November 30th. Cables, troughing, bitumen; pole-work, overhead work, switch-pillars; electric tramcars complete, for the Corporation tramways. See "Official Notices" November 9th.

Bray.—January 1st. High-tension switchboard and instruments for the U.D.C. electricity works. See "Official Notices" to-day.

Bridlington.—January 19th. Pumping machinery for the Corporation waterworks. See "Official Notices" to-day.

Dover.—December 6th. The Harbour Board invites tenders for supply of materials, including electrical requisites, for 12 months. Specification, 2s. 6d., from Martyn Mowll, Register of Dover Harbour, Castle Street.

Great North of Scotland Railway.—December 3rd. Tenders for electric lighting material. Forms from Stores Superintendent, Aberdeen.

Handsworth.—December 15th. Water-tube boilers, engine and dynamos for the U.D.C. See "Official Notices" to-day.

Heston-Isleworth.—Cable, troughing, tiles, pitch, &c. for the U.D.C. See "Official Notices" November 23rd.

India.—December 12th. Electric cranes for the East Indian Railway. See "Official Notices" to-day.

Italy.—December 31st. H.M. Consul at Rome (Mr. C. C. Morgan) has forwarded a copy of the plans, specification, &c. relative to the proposed construction of electric tramways in Rome. The scheme involves the construction of about 55 kiloms. of tramway lines. Competitors may tender, at their option, for a portion or the whole of the work, and may suggest modifications in the existing plans. Tenders will be received at the Municipal Offices, Rome, until December 31st. Specifications, &c., and plans, may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

New Zealand.—February 14th. The Auckland Municipal authorities require tenders by February 14th, 1907, for engines dynamos, boilers, switchboards, cable and other electrical plant. Particulars may be obtained from the city engineer.

North-Eastern Railway.—December 1st. Telegraph stores. Forms of application from Mr. C. H. Ellison, York. Sealed tenders, endorsed, to the Secretary, York, by 9 a.m. on date mentioned.

Portsmouth.—December 7th. Steam and other piping for the Corporation. See "Official Notices" to-day.

Portsmouth.—December 17th. Electric power cables for the Corporation works for the prevention of storm-water flooding. See "Official Notices" to-day.

Powell Duffryn Steam Coal Co., Ltd.—December 3rd. Tenders for electric fittings. Forms from Stores Manager, Aberaman Offices, Aberdare. Tenders to company's London office.

Rawmarsh and Swinton.—Free wiring installations for the Mexborough and Swinton Tramways Co. See "Official Notices" to-day.

Rochdale.—Static transformer and switchgear pillars. See advertisement this week.

Spain.—December 9th. The municipal authorities of Deva (province of Garpuzcoa) are inviting tenders until December 9th for the concession for the electric lighting of the town during a period of five years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Deva (Garpuzcoa).

Spain.—December 20th. Tenders to be sent to the "Casa Capitular," Almeria, for the public lighting of the outer suburbs of that town by means of 400 electric lamps of 5 C.P. The annual rental payable by the municipality is 11,600 pesetas (about £419), or such lower figure as the competition may elicit. A provisional deposit of 580 pesetas (about £20) is required to qualify any tender. Local representation is necessary.—*Board of Trade Journal.*

Sunderland.—November 30th. Four 350-KW. rotary converters, static transformers, and high-tension switchgear for the same. See "Official Notices" November 16th.

CLOSED.

Gosport and Alverstoke.—The D.P. Battery Co., Ltd., Bakewell, have secured the contract for 260 600-ampere-hour cells for the Gosport and Alverstoke electric lighting.

High Wycombe.—The T.C. has accepted the tender of Messrs. Meldrum Bros., Ltd., for the supply of a refuse destructor, at £3,842.

Leyton.—The U.D.C. has accepted the following tenders in connection with the tramway undertaking:—

Watlington & Co.—Tower wagon.
J. Sayer.—Destination Boards.

Middlesex.—The C.C. on November 22nd placed an order with Messrs. Dick, Kerr & Co. for the construction of a section of railway No. 15 from the "Case is Altered" public house to Craven Park, and the section of railway No. 8 from the Clock Tower, Harlesden, to Willesden Junction Station, at the same prices, and under the same schedules, at which the firm are constructing the section of line from Willesden Green to the "Case is Altered" public house. The estimated cost of the two sections in question is £30,000.

In connection with the laying of a tramway under the County of Middlesex Light Railway (No. 1) Order, 1903, the tender of Messrs. T. Docwra & Sons, at £998, for the reconstruction of King's Arms Bridge, Southgate, has been accepted.

Llandudno.—The Pier Co. has accepted the tender of Messrs. F. W. Smith & Co., Salford, for a 200-KW. dynamo, and that of Messrs. Kynoch, Ltd., for gas-producing apparatus and gas engines of 150 H.P.

London.—SOUTHWARK.—The B.C. has accepted the tender of the British Insulated & Helsby Cables, Ltd., for cable, at £2,131 13s. 4d. Eight tenders were received, at the following prices:—

British Insulated & Helsby Cables, Ltd.—(1) 1,150 yards ·6 × ·6 × ·20 (*a*) £1,533 6s. 8d. (*b*) (corrected to the current market prices of lead and copper in accordance with the sliding scales submitted by the firms tendering, copper £100, lead £18 per ton, £1,658 5s. 3d.); (2) 500 yards ·3 × ·3]× ·125 (*a*) £364 11s. 8d. (*b*) £395 10s. 11d.; (3) 440 yards ·1 × ·1 × ·05 (*a*) £132 (*b*) £142 18s.; (4) 440 yards ·05 × ·05 × ·025 (*a*) £79 15s. (*b*) £86 8s.; (5) feeder pillar, £22.

Siemens Bros.' Dynamo Works, Ltd.—(1) (*a*) £1,559 16s. (*b*) £1,684 13s. 3d.; (2) (*a*) £370 2s. 6d. (*b*) £401 6s. 6d.; (3) (*a*) £134 2s. 6d. (*b*) £145 13s. 9d.; (4) (*a*) £81 6s. 8d. (*b*) £88 1s. 11d.; (5) £22 9s.

Johnson & Phillips, Ltd.—(1) (*a*) £1,564 (*b*) £1,689 16s. 11d.; (2) (*a*) £370 (*b*) £400 9s. 1d.; (3) (*a*) £136 (*b*) £147 7s. 6d.; (4) (*a*) £81 (*b*) £87 10s. 9d.; (5) £23.

Henley's Telegraph Works Co., Ltd.—(1) (*a*) £1,572 10s.; (*b*) £1,697 15s. 7d.; (2) (*a*) £375 17s. 6d. (*b*) £406 18s. 2d.; (3) (*a*) £135 (*b*) £146 4s. 6d.; (4) (*a*) £81 15s. (*b*) £88 16s.; (5) £30.

St. Helens Cable Co., Ltd.—(1) (*a*) £1,570 (*b*) £1,699 0s. 11d.; (2) (*a*) £375 (*b*) £406 14s. 7d.; (3) (*a*) £141 (*b*) £153 1s. 6d.; (4) (*a*) £85 (*b*) £91 18s. 6d.; (5) £25.

The Western Electric Co., Ltd.—(1) (*a*) £1,581 5s. (*b*) £1,706 3s. 7d.; (2) (*a*) £370 16s. 8d. (*b*) £401 15s. 11d.; (3) (*a*) £137 10s. (*b*) £148 8s.; (4) (*a*) £82 10s. (*b*) £89 3s.; (5) £24.

Callender's Cable Co., Ltd.—(1) (*a*) £1,561 13s. (*b*) £1,687 9s. 11d.; (2) (*a*) £372 3s. 3d. (*b*) £403 19s. 7d.; (3) (*a*) £137 10s. (*b*) £148 15s.; (4) (*a*) £83 15s. (*b*) £90 10s. 6d.; (5) £25 10s.

W. T. Glover & Co., Ltd.—(1) (*a*) £1,580 (*b*) £1,705 3s. 10d.; (2) (*a*) £372 (*b*) £402 19s. 3d.; (3) (*a*) £135 (*b*) £145 10s.; (4) (*a*) £80 10s. (*b*) £87 3s. 6d.; (5) £27 10s.

METROPOLITAN ASYLUMS BOARD.—At the meeting of the Board on Saturday the engineer-in-chief reported the completion of Messrs. Bromley & Batstone's contract for installing electric light, telephone, and fire alarms, at the South-Eastern Asylum. The contract was £4,894. The total cost was £5,297.

L.C.C.—The Fire Brigade Committee of the L.C.C. has received the undernoted tenders for the wiring of fire brigade sub-stations at Hornsey Rise and Plumstead:—

1.—HORNSEY RISE STATION.

F. J. Coleby & Co.	(recom.)	£160	G. E. Taylor & Co.		£187
J. O. Grant & Taylor ..	..	161	Roger Dawson, Ltd. ..	..	192
Durell & Co. ..	..	165	L. W. Sunderland & Co.	..	194
Oliver Clark & Co. ..	..	171	Barlow & Young ..	..	208
Frank Suter & Co. ..	..	175	Blackburn, Starling & Co.	..	233
John Barker & Co. ..	..	177	J. Defries & Sons ..	..	234

2.—PLUMSTEAD STATION.

J. O. Grant & Taylor	(recom.)	£141	G. E. Taylor & Co.		£174
F. J. Coleby & Co. ..	..	157	L. W. Sunderland & Co.	..	181
Durell & Co. ..	..	159	Roger Dawson, Ltd. ..	..	188
Oliver Clark & Co. ..	..	159	Barlow & Young ..	..	198
John Barker & Co. ..	..	165	J. Defries & Sons ..	..	216
Frank Suter & Co. ..	..	165	Blackburn, Starling & Co.	..	220

The Stores Committee of the L.C.C. will report shortly on the tenders received for electric fittings, cables, &c., for the coming year.

The following offers have been received by the Highways Committee for the supply of switchgear at the sub-station at the Elephant & Castle:—

Ferranti, Ltd. ..	(accepted)	£1,954	British Westinghouse Co. ..	£2,493
General Electric Co.	..	2,489		

The British Westinghouse Co. is to supply 120 sets of electro-magnetic brakes for tramcars. Of these, 100 sets will be fitted to Maguire bogie truck cars equipped with Westinghouse motors, and will cost £56 10s. each, while 20 sets will be fitted to Brill bogie truck cars, which will be equipped with Dick, Kerr motors, and will cost £59 each.

Mirfield.—The U.D.C. has accepted the tender of the W. & T. Garnet Cable Co. and Callender's Cable & Construction Co. for the supply of cables.

Natal Government Railways.—Messrs. Bruce Peebles and Co. have received a further motor-converter order from Messrs. Hubert Davies & Spain.

Portsmouth.—The Drainage Committee has accepted the tender of Messrs. Johnson & Phillips for the supply of electrical gear for the pumps at the Southsea drainage works, at £2,230.

Redditch.—Messrs. Handley & Shanks, of Birmingham, are carrying out the complete electric light installation for the new works of the Enfield Cycle Co., Ltd., at Redditch.

West Ham.—The Corporation has accepted the following tenders:—

British Westinghouse Co.—Sub-station transformers, from 2,000 to 100 volts, £96 each; for four to six, power station feeder boosters, £80 each; testing transformer for 6,000-volt high-tension cable, £62.

Coulson, Stokes & Co.—Chequer plating for turbine at generating station, £35.

Phillips & Co.—1,000 tons of Ridding's coal, 10s. 6d. per ton, delivered alongside wharf.

India-rubber by any other Name, &c.—The *Tribune* says:—"While Mme. Bernhardt was speaking, a short circuit in the electric light occurred, and a strong smell of burning india-rubber spread through the building. No one was seriously hurt." Mme. Bernhardt ought to be severely reprimanded. How thankful she ought to be that nobody was seriously hurt by that smell!

FORTHCOMING EVENTS.

To-day's Events (Friday, November 30th).—At 7.30 p.m. Institution of Electrical Engineers (Manchester Students). Mr. L. H. A. Carr on "Trolley *v.* Conduit."

At 8 p.m. Institution of Mechanical Engineers. Discussion on Mr. T. Clarkson's paper "Steam as a Motive Power for Public Service Vehicles."

Northampton Institute Engineering Society. Mr. F. A. Thompson on "Switchboards and Switchgear."

At 8 p.m. Institution of Civil Engineers (Students). Mr. P. A. Spalding on "Applications of Electricity in Printing Works." Sir Alex. Kennedy will preside.

Junior Institution of Engineers. Visit to the Great Northern, Piccadilly and Brompton Railway.

Saturday, December 1st.—Institution of Electrical Engineers (Manchester Students). Visit to the Lancashire Power Co.'s generating station.

Monday, December 3rd.—At 7.30 p.m. British Empire Motor Trades Alliance. Second annual dinner at the Hotel Russell, W.C.

At 8 p.m. Junior Institution of Engineers. Meeting with the discussion section of the Architectural Association. Mr. A. Hunter on "The Structural Design of Engineering Factories."

Institute of Marine Engineers. Meeting.

Tuesday, December 4th.—At 4.30 p.m. Society of Arts. The Hon. Sir Lewis Mitchell on "The Cape to Cairo Railway."

At 7.30 p.m.—Institution of Electrical Engineers (Manchester). Mr. Miles-Walker on "Rotary Converters *v.* Motor-Generators."

At 8 p.m. Institution of Civil Engineers. Mr. E. P. Hill on "The Yield of Catchment Areas."

Institution of Civil Engineers. Meeting.

Wednesday, December 5th.—At 11 a.m. At Central Station. North of England Institute of Mining and Mechanical Engineers. Visit to inspect Electric Winding Plant, &c., at Axwell Park Colliery.

At 7.30 p.m. Institution of Electrical Engineers (Students). "The Equipment of Steam Turbine Generating Stations," by Mr. R. J. Kaula.

At 8 p.m. Society of Arts. "The Metric System," by Col. Sir Chas. M. Watson.

Thursday, December 6th.—At 8 p.m. Institution of Electrical Engineers. Discussion on Prof. J. Epstein's paper on "Selection and Testing of Materials for Construction of Electric Machinery."

At 8 p.m. Civil and Mechanical Engineers' Society. Mr. R. J. P. Briggs on "Boilers and their Accessories."

At 8.30 p.m. Chemical Society. Meeting.

Friday, December 7th.—Northampton Institute Engineering Society. Visit to Robertson's Electric Lamp Works, Hammersmith.

At 7 p.m. N.E. Coast Institution of Engineers and Shipbuilders. Dinner at the Westgate Assembly Rooms, Newcastle.

Saturday, December 8th.—At 10 a.m. Institution of Electrical Engineers (Students). Visit to the North London Railway Works, Bow.

At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Meeting.

At 3 p.m. Junior Institution of Engineers. Visit.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued:—

Monday, December 3rd.—"A" Company, recruits' infantry drill, 6 p.m.; technical drill, 7 p.m.; non-"A" Badge men, 7 to 8.30 p.m.; "A" Badge men, 8.30 to 9.30 p.m.

Tuesday, December 4th.—"B" Company, technical drill, 6 p.m.

Wednesday, December 5th.—"A" Company, Hopkinson Cup Team, 6 p.m.

Thursday, December 6th.—"C" Company, drill for guard of honour, 7 p.m.; technical drill for those not attending the guard of honour, 7 p.m.

Friday, December 7th.—"D" Company, technical drill for Hopkinson Team, 5 p.m.; technical drill for remainder, 7 p.m.

Saturday, December 8th.—"D" Company, Hopkinson Cup Team (at H.-Q.), 2 p.m.; "B" Company, night run at Gravesend.

WILFRID C. DUMBLE, Captain R E., Adjutant,
For O.C.E.E.R.E. (V.).

NOTES.

Deferring the "First Hour."—A good and true story is being told (says "W. H. F." in the *Surrey Comet*) anent the Kingston Corporation electric light undertaking. Under the "maximum demand" system consumers are charged for the first hour's consumption each day at the maximum rate of 7d. per unit on the largest number of lamps that have been in use during the quarter at any one time, the balance being charged at 3d. per unit. An astute Kingston tradesman on receiving his account complained that he was charged for so many units at 7d., and claimed that he should only have been charged at 3d. When he was told that for the first hour the charge was 7d., he exclaimed triumphantly, "Ah! but I burnt gas for the first hour!"—*The Surveyor.*

Copper from Japan.—Owing to the high prices now ruling for copper, the exports of Japanese copper to European markets have largely increased, and the total shipments from that country to Europe from January 1st to October 31st are estimated at 10,000,000 lb., as compared with only 60,000 lb. in the corresponding period of 1905. The production of copper has also increased considerably, and since the conclusion of the war mine-owners have been doing their utmost to develop the industry by installing modern machinery. The total production of the four largest Japanese mines last year amounted to 63,718,000 lb.—*Birmingham Daily Post.*

The Suppression of Industrial Smoke.—The burning of bituminous coal in the United States is by no means carried out on the best lines all round, but there does seem to be an appreciation of the fact that smoke need not be made. Mr. Bement, in a recent paper before the Western Society of Engineers, says that there are three classes responsible for smoke—to wit, the manufacturers of furnace apparatus; consulting engineers and architects; and purchasers who operate apparatus. He says that, with one possible exception, no smokeless apparatus, strictly speaking, is made. The requirements for smokeless combustion he lays down as, first, a uniform evolution of the volatile gases, which implies, of course, mechanical feeding of the fuel; secondly, a sufficiently capacious mixing chamber of refractory material wherein the gases and air shall mix and combine. These are the requirements which we have for years laid down as essential with, we fear, but little result in converts. Temperature is essential, and is secured by the nature of the chamber; but, as Mr. Bement points out, temperature is merely an indispensable adjunct to proper air mixture. The illustration given of this smokeless furnace is shown with a chain-grate stoker, an arch over the grate, a tile covering over the lower row of tubes of the boiler (which is of Babcock or similar type), and a couple of vertical baffle walls in the length of the tubes, so arranged that the gases travel to the back of the boiler, then rise across the tubes, pass down between the two baffles, and thence under the foremost baffle and up through the nest of tubes to the chimney, which is here shown at the front end of the boiler above the steam drum.

The general opinion of those who discussed the paper was that by means of proper furnaces, smoke could be easily prevented. As here so in America, boiler owners raise all manner of objections when the smoke Acts are enforced against them. They purchase boilers with furnaces wholly unfit for proper bituminous combustion, and apparently they are called on, as we are, to listen to the special pleading of a host of what have been called 100 per cent. efficiency patent mongers all shouting the beauties of their own special apparatus, as though apparatus could replace principles, neglecting meantime the simple principles by which alone, as Mr. Bement says, a cure can be effected. Mr. Bement might have written his paper for London, but we fear he would have received less appreciation than he is doing in Chicago, where the engineers of large steam plants actually consider that smoke is preventible, but they do not profess to attempt to burn bituminous coal without proper furnace forms and materials, though they appear to have among them quite as many sellers of apparatus which, while perhaps good for one item in the process, is sold as possessing and embodying the whole secret and, of course, ends in disappointment. Constant gas evolution, proper air mixture, sustained temperature: each of these is essential or desirable, the latter two are absolutely essential and non-separable, and they demand a time element also.

A Mine Explosion.—A Bristol paper says that the inquiry into the explosion at Cilfyndd, Pontypridd, whereby six men lost their lives a fortnight ago, took place on 26th inst., and in accordance with the theory propounded by the management and Inspector of Mines, the jury returned a verdict that the explosion was caused by the emission of sparks from an electric battery used for lighting the colliers' lamps in the mine, but that no fault or neglect could be attached to any person concerned.

A Westinghouse Club.—In the Stretford Town Hall recently, a smoking concert was held by the members of the newly-constituted Engineers' Club of the British Westinghouse Co. The object, explained the chairman (Mr. J. S. Peck), is "to promote social and athletic pursuits, to inculcate a feeling of good-fellowship, and to disseminate electrical and engineering knowledge among its members. The *Manchester Courier* says that the membership of the club is limited to the company's employés, and there are three classes of members—(*a*) general, (*b*) technical, and (*c*) athletic. The general members are entitled to all the privileges of the club. Meetings will be held fortnightly, and will be conducted by the chiefs of the technical staff. The list of vice-presidents, all giving their active support, includes Mr. P. A. Lange (manager of the British Westinghouse Co.), Messrs. Schoepf, Miles Walker, McLean, London and Von Abernon, severally experts on colliery plant, turbines, generators, insulation, motor traction, transformer design and the subject of alternating currents. The membership already numbers close on two hundred. The president is Mr. N. Carlton, the treasurer is Mr. J. Harding and the secretary Mr. T. Hart. The next meeting of the technical members will be held on December 5th, when the chairman (Mr. J. S. Peck) will read a paper on "High-Tension Transmission."

Electric Shock Fatality.—On the 23rd inst., at Messrs. Turnbull & Stockdale's Rose Bank Bleach Works, Stubbins, Ramsbottom, Thomas Birch, aged 33, of Edenfield, engineer, met his death. He was found in the engine room of the works with a lighted lamp clasped in both hands close to his breast, and was in a paralysed state. When the electric current was switched off, he fell in a heap and died instantly. It is computed that he received a shock at 440 volts. He had been employed at the works about four years.

P. & O. Batti-Wallahs' Society.—The members of this Society had a very enjoyable smoking concert on Wednesday, the 21st inst., and the programme, which was made up by members and their friends, was carried through very successfully, Mr. L. M. Waterhouse being in the chair. Mr. F. B. Joseph gave a very interesting song to the tune of "Tommy Atkins," entitled "The Batti-Wallah," and this was exceptionally well received.

A Smoke Prosecution that Failed.—At Kensington Petty Sessions recently the Underground Electric Railways Co., Ltd., was summoned for smoke nuisance at Lot's Road power station. After a full hearing the Court said they were satisfied that the company had exercised every care, and dismissed the summons.

Parliamentary.—Metropolitan Electric Supply Bill.—This Bill was before the Chairman of Committees in the House of Lords on the 23rd inst. Formal evidence having been given, the Bill was allowed to proceed to the third reading stage.

British Turbo-Generators.—By reason of the peculiar conditions under which turbo-generating machinery operates, it has been generally expected that its performance would be less satisfactory than that of lower speed machinery. The interesting series of "Howard" Lectures by Dr. Silvanus Thompson, which has been reproduced in abstract in these columns, ably describes the methods by which the various designers are meeting the difficulties created by the increased speed of the rotors, and it is satisfactory to note that British manufacturers are more than holding their own, not only in design, but also in the much more important matter of performance.

It may be argued that the high standard of British-made electrical machinery is, to some extent, due to the rigid conditions which are usually insisted upon by consulting engineers; on the other hand, the conditions which British machinery is called upon to fulfil might often be relaxed with considerable advantage to the home manufacturer. Take, for instance, the permissible rise in temperature of a machine under running conditions, which has a very material influence upon the cost of such a machine. While British conditions usually insist that the temperature rise shall not exceed 70° F., our Continental neighbours are permitted a rise of from 84° to 90° F., and such a temperature rise has been adopted by the manufacturers as a body. It will be seen, therefore, that there is a very wide difference between British and Continental standard practice, and though we think the Continental temperature rise is rather high, it must be admitted that there are a good many foreign-made machines operating in this country, with such a temperature rise, and yet giving perfectly satisfactory results. The remarkable thing is that Continental manufacturers usually state plainly that they will not abide by the British standard of temperature rise, and yet their machines are frequently accepted. When there is a disposition to accept a Continental machine with high temperature rating, it should be clearly laid down that British manufacturers are permitted some variation from their standard practice. We are not urging this with any desire to lower the standard of electrical machinery, but we are desirous of seeing that home manufacturers are given equal chances with their foreign competitors.

Reverting, however, to the question of turbo-driven machinery, it was generally supposed that this type of generator could not be designed to give large overloads, and at the same time conform to the usual British standard in regard to temperature rise. It is, therefore, interesting to note that some recent tests have been made by Messrs. Dick, Kerr & Co., to determine whether turbo-driven machinery could be operated with no greater rise in temperature than ordinary low-speed machines. The tests were carried out on a 3,000-kw. turbo-alternator, which has been in operation on the Glasgow Corporation mains for some fourteen months. The machine was running for a little over seventeen hours. At 5.30 a.m. it was put on the town mains, and delivered an average output of 3,000 kw., on an induction motor load. It ran thus until 7.50 p.m., when it was immediately switched on to an artificial load averaging 3,000 to 3,200 kw. It was run for three hours under such conditions, and as during the last hour the temperature was stationary, it was assumed that the machine had reached its maximum temperature. The temperatures were as follows:—

On one side of machine,	Air temperature ...	86° F.	
	Iron core	160° F.	Rise 74° F.
Opposite side of machine,	Air temperature...	76° F.	
	Stator windings ...	139° F.	Rise 63° F.
	Iron core	142° F.	Rise 66° F.
	Rotor windings ...	118° F.	Rise 42° F.
	Collector rings ...	108° F.	Rise 32° F.

A Correction.—With reference to a leaderette which appeared in our issue of last week, under the heading "Electric Tramway By-laws," commenting on a recent action brought by the Norwich Electric Tramways Co., the engineer (Mr. A. N. Banister) points out that certain of our statements were incorrect. The tramways do not belong to the Norwich Corporation, but to the Norwich Electric Tramways Co. He also says that the Lord Chief Justice did not express a view that the by-law was unreasonable. Had he been present in Court he would certainly have heard the Lord Chief Justice say this or something very like it in the course of the argument, but after the address of counsel for the company, he came to a different conclusion because of certain former cases. Our correspondent also points out that in sending the case back to the Justices, the Lord Chief Justice did not say it was a case in which there should not be a conviction. What he did say was "the case must go back for further consideration, but not necessarily with an instruction that they ought to convict"—a very different thing. Mr. Justice Darling disagreed, saying "he was not so clear as to the desirability of not inflicting a penalty in this kind of case." We think we gave our correspondent the benefit of Mr. Justice Darling's opinion.

Steam v. Electricity for Pumping.—The Corporation of Bridlington is considering the installation of new plant at the waterworks, and has obtained tenders for steam and suction gas pumping plant, but, strange to say, never thought of using electricity, although it has its own electricity works! If there is one kind of work more than another which can be profitably carried on with electrical motive power, it is pumping, and where both the pumping plant and the electricity works are in the same hands, as in this case, the combination is ideal. Not only is the electrical pumping plant by far the cheapest in first cost, and highly efficient, but also it provides a steady day load for the electricity works, a load, too, which can be cut off during the 'peak" hours. The borough electrical engineer, Mr. A. J. Beckett, has naturally bestirred himself with a view to preventing the commission of an absurd engineering error; he offers electrical energy at 1d. per unit, and has succeeded in inducing the Council to call for tenders for electrical pumps. The Council seems to doubt whether electricity is adaptable and sufficiently reliable for the purpose, being apparently ignorant of the immense development of electrical power transmission during the last decade.

Rail Corrugation.—In our "Correspondence" columns we say that the result of our attempt to reproduce Mr. L. Harvey's photograph of a rail with corrugated web will be found here; unfortunately, it has not proved satisfactory, and we are obliged to defer the matter.

Institution and Lecture Notes.—The Tramways and Light Railways Association.—The offices of this Association are now at 35, Parliament Street, Westminster, London, S.W. The *Official Circular* of the Association for November contains the Council's report for the year ended December 31st, 1905, and a notice of important changes in the constitution which will be brought forward at the general meeting, to be held on Tuesday, December 4th. Mr. A. de Turckheim has been appointed secretary in the place of Mr. Ernest Benedict, who has resigned after five years' service.

Incorporated Association of Electric Power Companies.—On and after December 1st the registered offices will be at 35, Parliament Street, Westminster, S.W., and the telephone No. 2110 Victoria. Mr. A. de Turckheim is secretary.

Appointments Vacant. — Chief assistant electrical engineer for Southend-on-Sea; junior engineer-in-charge for Darlington; a junior assistant electrical engineer for Leek at 25s. See 'Official Notices" to-day.

Manufacturers and Town Clerks.—We have been asked by a borough electrical engineer to draw attention to the practice followed by some manufacturing firms, of addressing the town clerk on technical matters, soliciting orders from him, and so on. Seeing that town clerks are solicitors by profession, and have, or ought to have, no influence whatever over the management of the engineering departments of a municipality, this practice can only be regarded as highly objectionable. It looks like "trying to run behind the engineer's back," and is certainly calculated to "put his back up." In their own interests, therefore, firms would be well advised to deal only with the engineer.

Brush Turbo-Alternator.—We are indebted to the Brush Electrical Engineering Co., Ltd., for a handsome framed photograph of one of their 1,000-kw. turbo-alternators.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—At Radcliffe on November 17th the members of the staff of the Lancashire Electric Power Co. presented Mr. R. L. Gamlen, who had been chief engineer and manager since the inception of the company, with a silver tea and coffee service of old English pattern. Mr. Gamlen had arranged to leave England on Thursday last week to take up similar duties in connection with a large new electrical engineering concern at Calcutta. About 60 members of the staff were present. Mr. Burkinshaw, station superintendent, made the presentation. Mr. Gamlen, in accepting the gift, said if any strength had been vouchsafed to him in the uphill task which had fallen to his lot in Lancashire, it had come from the staff which had been loyal and helpful to him from the highest to the lowest. His difficulties had been enormous, and almost on every hand, but he was proud to think that the position of the Lancashire Electric Power Co. was now as favourable as that of any of the great companies of England, Scotland, or Wales. In the evening the members of the Manchester staff adjourned to the Midland Hotel, Manchester, to partake together of a repast.

Mr. S. L. Faithfull has been appointed assistant electrical engineer to the Pretoria municipality, at a salary of £50 per month. There were 76 applicants for the appointment.

Mr. Arthur L. Johnson is leaving the Brighton electricity works to to take up a post as sub-station assistant under the L.C.C. tramways.

Mr. C. D. Taite has resigned his appointment as borough electrical engineer of Salford, in order to join the staff of the Lancashire Electric Power Co., as engineer and manager, vice Mr. R. L. Gamlen, who, as above stated, has taken up an appointment in Calcutta. Mr. Taite will commence his new duties about the new year.

Tramway Officials.—The Tramway Committee of the Exeter T.C. has recommended the payment of £300 to the surveyor, and £100 to the electrical engineer, for special services in connection with the tramway contracts.

The Lancaster Committee has appointed Mr. W. T. Charlton traffic superintendent, promoting him from the inspectorship.

General.—At the opening meeting of the newly-constituted Liverpool Tramways and Electric Lighting Committee, Sir Charles Petrie was unanimously and cordially re-elected chairman, and Alderman F. Smith deputy-chairman, for the ensuing year. Councillor W. W. Walker was re-elected chairman of the Electric Power and Lighting Sub-Committee, and Councillor E. L. Lloyd of the Finance and Traffic Sub Committee.

Councillor James Heald (head of the firm of Messrs. Calvert and Heald, electrical engineers, &c.) has been re-elected chairman of the Electricity Committee of the Lancaster Corporation.

Mr. W. Foster, collector to the Fleetwood E.L. and P. Syndicate, has secured an appointment in the E.L. Consumers' Department of the Birmingham T.C.

Ex-Bailie James Willock, after being convener of the Electricity Committee of the Glasgow Corporation for four years, has just been succeeded in that office by Councillor J. W. Stewart. This change is rendered necessary by a new regulation which stipulates that no convenership can be held by any member of the Council for a longer period than three years. During his tenure of office as convener, Bailie Willock has taken a keen interest not only in the electricity department but in everything appertaining to the electrical profession. He represented the department on several occasions at the annual conventions of the Incorporated Municipal Electrical Association, and was always a prominent contributor to the discussions at these gatherings. Councillor J. W. Stewart, the new convener, was sub-convener under Bailie Willock and chairman of the Sub-committee on Finance.

Mr. Sydney H. Bill, of Dudley, has been appointed electrical engineer to the Mersey Docks and Harbour Board.

Messrs. W. T. Glover & Co., Ltd., have appointed Mr. J. H. C. Brooking as their sole representative for the North-Eastern District of England, and the South-Western district of Scotland. Mr. Brooking has been engaged with the firm during the last 10 years, both upon outside contracts, and at their works at Trafford Park.

Obituary.—Friends of Mr. W. P. J. Fawcus will regret to learn of the loss by that gentleman of his only daughter, Alice. The news was telegraphed from Aden. The young lady, with her second brother, was on the way to Mombasa, near which place Mr. Fawcus has purchased an estate.

NEW COMPANIES REGISTERED.

Thomas R. Martin & Co., Ltd. (90,825).—This company was registered on November 15th, with a capital of £3,000 in £1 shares, to acquire the business of an electrical manufacturers' agent and merchant carried on at Middlesbrough, by Thomas R. Martin, and to carry on the said business and that of electricians, mechanical engineers, manufacturers of electrical apparatus and appliances, producers and suppliers of electricity, light and motive power, &c. The first subscribers (each with one share) are:—T. R. Martin, 31, Albert Road, Middlesbrough, electrical engineer; H. Storry, Ivy House, Woodlands Road, Middlesbrough, house furnisher; W. H. Hinton, The Homestead, Middlesbrough, grocer; F. Storry, Ivy House, Woodlands Road, Middlesbrough, house furnisher; Maude Taylor, 13, Cleveland Terrace, Middlesbrough, cashier; W. Beach, 32, Lennox Street, Middlesbrough, clerk; and A. H. France, 23, Coral Street, Saltburn-by-Sea, secretary. No initial public issue. The number of directors is not to be less than two or more than seven; the first are T. R. Martin and A. H. France; qualification, 200 shares; remuneration as fixed by the company. Registered office, 31, Albert Road, Middlesbrough.

Municipal and General Properties Syndicate, Ltd. (90,776).—This company was registered on November 12th, with a capital of £10,000 in £1 shares, to carry on the business of financiers, concessionaires, commission agents, underwriters, bankers, contractors, capitalists, promoters, owners and workers of light railways, tramways and electric light, power and traction, gas, water, and other undertakings. The subscribers (each with one share) are:—W. J. Balfour-Murphy, 52, Stanger Road, South Norwood, electrical engineer; A. H. Gordon, 20, Earl's Court Gardens, S.W., secretary's assistant; R. F. Juniper, 17, Beresford Gardens, Seven Kings, cashier; J. F. Fordham, 6, Medley Road, West Hampstead, book-keeper; C. C. Willson, Finsbury Pavement House, E.C., incorporated accountant; H. E. Gibbins, 4, Georgette Place, West Greenwich, S.E., clerk; P. Wild, 57, Trafalgar Road, Greenwich, clerk. No initial public issue. Table "A" mainly applies. Registered by Pemberton, Cope, Gray & Co., 5, New Court, Lincoln's Inn, W.C. Registered office, Finsbury Pavement House, E.C.

Oliver Arc Lamp, Ltd. (90,880).—This company was registered on November 20th, with a capital of £2,000 in £1 shares, to acquire and carry on the business of electrical engineers and arc lamp manufacturers carried on at Cambridge Place, Burrage Road, Woolwich, as "Oliver & Co.," and to adopt an agreement with G. S. Hunt, C. Oliver, and W. M. D. Pell. The first subscribers (each with one share) are:—G. S. Hunt, Sandfield, Chislehurst, Kent, gentleman; Mrs. A. M. E. Hunt, Sandfield, Chislehurst; C. Oliver, 16, Montpelier Row, Blackheath, engineer; W. M. D. Pell, 29, Quinton Road, Blackheath, electrical engineer; B. H. Churion, Hellyer, Surbiton, Surrey, engineer; F. B. Pell, 17, Lissenden Mansions, N.W., electrical engineer: G. Oliver, M.D., Riversleigh, Farnham, Surrey. No initial public issue. The number of directors is not to be less than two or more than five; the first are G. S. Hunt, C. Oliver and W. M. D. Pell (all permanent, subject to holding £400 shares or stock, other than debenture stock, each). Remuneration of two last named directors £150 each per annum; of others not stated. Registered office, Cambridge Place, Burrage Road, Woolwich.

Gauntlett (Italian) Co., Ltd. (90,908).—This company was registered on November 22nd, with a capital of £20,000 in £1 shares, to acquire (*a*) a licence to use and vend the Sherardizing process of depositing zinc on metals in the preparation of plates as substitutes for lithographic stones, under an Italian patent dated March 28th, 1902, and (*b*) an Italian patent dated February 15th, 1904, granted to G. Bower and F. W. Gauntlett, for improvements in substitutes for lithographic stones, to adopt an agreement with J. D. Adams, and to carry on in Italy or elsewhere the business of lithographic plate manufacturers, galvanisers, electro-platers, lithographers, manufacturers of electrical apparatus, &c. The first subscribers (each with one share) are:—J. D. Adams, Tugle Lodge, Addlestone, engineer; F. W. Gauntlett, 2, Tower Royal, E.C., lithographer; J. Johnstone, 17 and 18, Basinghall Street, E.C., solicitor; L. P. Stephen, Oxford Mansions, Oxford Street, W., solicitor; C. J. Baker, 43, Lydhurst Avenue, Streatham Hill, S.W., clerk; F. W. Godwin, 481, Hanover Buildings, Tooley Street, S.E., clerk; and E. Mills, 48, Arodene Road, Brixton Hill, S.W., rate collector. Minimum cash subscription 25 per cent. of the shares offered to the public. The number of directors is not to be less than two nor more than seven. The first are J. D. Adams, F. W. Gauntlett, J. Johnstone, L. P. Steven, C. J. Baker, F. W. Godwin and E. F. Mills; qualification, £50; remuneration, £100 each per annum.

Tyneside Electrical Development Co., Ltd. (90,884).—This company was registered on November 20th, with a capital of £100,000 in £1,000 shares, to generate, store, transmit, purchase, sell, supply and distribute electrical or other energy for motive power, light, heat or other purposes, to construct, equip, improve, develop and control public and private works and conveniences, including electrical power and light supply works, telephone and telegraph works and the like, to apply for or procure the transfer of Acts of Parliament, Provisional or other Orders, contracts and concessions, and to carry on the business of electrical engineers and contractors, &c. The first subscribers (each with one share) are:—F. S. Newhall, Castle Hill, Wylam, gentleman; N. V. Noble, 102, Grey Street, Newcastle-on-Tyne, banker; G. B. Richardson, Wallsend Shipyard, Wallsend, shipbuilder; J. H. Armstrong, St. Nicholas Chambers, Newcastle-on-Tyne, chartered accountant; J. Tennant, Fairlieburne, Fairlie, N.B., lead manufacturer; G. E. Henderson, 16, Framlington Place, Newcastle-on-Tyne, gentleman; and A. N. L. Wood, The Hermitage, Chester-le-Street, coal owner. No initial public issue; the number of directors is not to be less than three or more than seven; the first are J. H. Armstrong, J. T. Merz and F. S. Newhall; qualification, £1,000; remuneration, £150 per annum, divisible. Registered office, St. Nicholas Chambers, Amen Corner, Newcastle-on-Tyne.

Gould Storage Battery Co., Ltd. (90,877).—This company was registered on November 20th, with a capital of £25,000 in £1 shares, to carry on the business of manufacturers of storage batteries, electricians, electrical and mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, manufacturers of electrical apparatus and accessories, motor-car and launch builders, &c. The first subscribers (each with one share) are:—W. G. H. Cooper King, Birkbeck Bank Chambers, W.C., solicitor; R. R. Weston, Albert Villa, Townsend Road, South Tottenham, managing clerk; Miss H. Ablin, 22, Queen's Head Street, Islington, N.; Miss G. M. Robertson, 37, Shalimar Gardens, Acton, W.; C. Piper, 1, Railway Side, Barnes, S.W., clerk; Miss S. Ablin, 22, Queen's Head Street, Islington. N.; and E. Starie, 10, Collingbourne Road, Shepherd's Bush, W., clerk. No initial public issue. The number of directors is not to be more than seven; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company.

Hopkinsons, Ltd. (90,924).—This company was registered on November 23rd, with a capital of £100 in £1 shares, to carry on the business of mechanical and electrical engineers, manufacturers of gas and oil engines, dynamos, electric, hydraulic, pneumatic and other apparatus, implements and instruments, gas and water plant, and the like, galvanisers, electro-platers, &c. The first subscribers (each with one share) are:—J. Hopkinson, Cleveland House, Huddersfield, mechanical engineer; F. A. Hopkinson, Lawrence Dene, Huddersfield, mechanical engineer; A. H. Hopkinson, Belvidere, Huddersfield, mechanical engineer; L. H. Hopkinson, Cleveland House, Edgerton, Huddersfield, mechanical engineer; J. N. Bygott, 8, Norman Avenue, Birkley, Huddersfield, managing clerk; A. Walker, Glen Field, Deystan, Huddersfield, dyer and finisher; A. A. Lee, Moor View, Honley, near Huddersfield, vocalist. No initial public issue. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lowdon Electric Lamp Co., Ltd. (London) (83,470).—A memorandum of satisfaction in full of a debenture dated September 22nd, 1905, securing £100, has been filed.

Durham Collieries Electric Power Co., Ltd. (83,421).—A charge dated October 25th, 1906, to secure £18,000, has been registered. Property charged: Certain leasehold premises at Newbottle, Houghton-le-Spring, lands at Newbottle and South Biddick, and the company's general assets, present and future, including uncalled capital. Holders: The Trustees, Executors and Securities Insurance Corporation, Ltd., Winchester House, E.C.; and the Industrial and General Trust, Ltd., Princes Street, E.C.

Cleminson Electric Lamp Attachment, Ltd. (80,145).—This company's annual return, made up to December 31st, 1905, was filed on October 8th, 1906. 2,351 shares have been taken up out of a nominal capital of £2,500 in £1 shares. £1 per share has been called up on 901, and £901 has been received. 1,450 shares are considered as fully paid. Mortgages and charges: Nil.

Andrews & Mumford, Ltd. electricians, Camberwell (88,836).—A debenture dated September 23rd, 1906, to secure £100, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: R. R. Mumford, Kirby Lodge, Hardy Road, Blackheath.

C. & A. Musker (1901), Ltd., electric and general engineers, Liverpool (70,573).—A trust deed dated November 1st, 1906, to secure £50,000 mortgage debenture stock, has been registered. Property charged: Freehold hereditaments at Tuebrook, Liverpool, and the company's general assets and undertaking for the time being. Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C.

Flather & Co., Ltd. (74,602.)—This company's annual return was filed on October 11th, when 1,527 shares had been taken up out of a nominal capital of £3,000 in £1 shares. £1 per share has been called up on 27, resulting in the receipt of £27. £1,500 is considered as paid on the remainder. Mortgages and charges: £1,000.

Electric Supply Co. of Victoria, Ltd. (66,059.)—This company's annual return was filed on September 28th, when 125,000 preference and 125,000 ordinary shares had been taken up out of a nominal capital of £300,000 in 150,000 preference and 150,000 ordinary shares of £1 each. £1 per share has been called up on 7, resulting in the receipt of £7. 249,993 shares are considered as fully paid. Mortgages and charges: £160,000.

Camberley Electric Supply Co., Ltd. (81,400).—This company's annual return, made up to January 14th, was filed on September 24th. Seven shares have been taken up out of a nominal capital of £1,000 in £1 shares, and nothing has been called up. Mortgages and charges: Nil.

Chloride Electrical Storage Co., Ltd. (35,389).—This company's annual return, made up to August 29th, was filed on September 28th. 62,000 preference and 33,250 ordinary shares have been taken up out of a nominal capital of £135,250 in 62,000 preference, 33,250 ordinary, and 40,000 undenoted shares of £1 each. £1 per share has been called up on 48,750 preference, and 16,250 ordinary, and £65,000 has been received. £30,250 is considered as paid on 13,250 preference, and 17,000 ordinary. Mortgages and charges: Nil.

CITY NOTES.

Aron Electricity Meter, Ltd.

The directors in submitting the eighth annual accounts for the year to September 30th, 1906, say that the profit and loss account for the year, after providing for general charges, depreciation and share of expenses and discount on the issue of debentures, shows a net profit of £17,213, making, with the balance of £4,016 carried forward from last year, a total available profit of £21,229. Of this amount there will be set aside for the debenture sinking fund, in accordance with the terms of the trust deed, £2,500. Out of the balance of £18,729, the directors recommend the payment of 6 per cent. on account of preference dividends in arrear, absorbing £7,494, leaving £11,235 to be disposed of. Of this amount the directors propose putting aside for the purpose of writing off the expenses connected with the issue of debentures, and the advance to the American company, the sum of £4,818, and to carry forward £6,417. Trade in Germany and Austria has continued to be very satisfactory. Business in France has considerably improved and has commmenced to contribute to the profits of the company. From all appearances the directors are justified in hoping that the same may be said of the English business in the ensuing year. The company is continuing to reap adequate results from the increased capital expenditure at the works in Schweidnitz and Charlottenburg. The directors have carefully considered the question of arrears of dividends due to preference shareholders, and it is their intention, should business continue as at present, to make a further distribution on April 1st next.

Cleveland and Durham Electric Power, Ltd.

The statutory meeting was held on the 21st inst., at the Station Hotel, Newcastle-on-Tyne.

Mr. Charles Emmott, who presided, said that they had not been idle since the prospectus was circulated. The negotiations for floating the company had been carried through with success, although it had been said that at the date of the issue the prospects were not very promising. The staff of the company had been organised with a view to efficiency, and alterations were being carried out on the plant at the Grangetown Power Station, which would increase the capacity from 4,800 to 8,000 kw. The work had been pushed on day and night, and it was hoped that within, perhaps, a month, subject to unforeseen causes, a supply would be available. Bishop Auckland Station was now being supplied in bulk, and the prospects there were most satisfactory. At Consett arrangements were in preparation also for a bulk supply. As regarded new custom, and this was the most important part of the enterprise, the supply of a large amount of power, representing over 10,000,000 units, had already been arranged for in South Durham, and along the Tees, and negotiations had been opened up for a further large supply. As regarded supplying the Cleveland Iron Mines, work had already been commenced. The laying of the cables and the necessary overhead lines would, it was hoped, be completed within seven months; there was a very large field there, which would lead to important business. The estimated horse power which would come under negotiation in the Tees, Bishop Auckland, Consett and Northern areas, would be from 220,000 to 230,000, and it was quite possible, with the arrangement in contemplation, to supply power with profit to both the manufacturer and the company.

Sir John D. Milburn, Bart., seconded the report, and drew attention to the fact that in the Northern Counties Electricity Supply Co., Ltd., the company had a going concern, the revenue of which at present amounted to something between £25,000 and £30,000, and with the assistance of this company, the shareholders might hope to derive a good deal of profit out of that company in the future.

The motion was carried unanimously.

Official Announcements re Companies.—The following are to be struck off the register within three months unless cause is shown to the contrary:—

Acetylene Gas and Electric Smelting Co., Ltd.
Automatic Telegram and Letter Delivery Co., Ltd.
British Arc Carbons Manufacturing Co., Ltd.
English Power Co., Ltd.
L'Auto-régulateur Moteur Hydraulique "Cassell" Ltd.
Liverpool Electric Supplies, Ltd.
M.I.P. Electrical Syndicate, Ltd.
New Century (Foreign) Arc Light Co., Ltd.
Ozone Generators, Ltd.

The Western Telegraph Co., Ltd. — The directors have declared an interim dividend, payable on December 21st, of 3s. per share, or at the rate of 6 per cent. per annum, free of income-tax, for the quarter ended September 30th, 1906. The transfer books will be closed from December 14th to 20th, both days inclusive.

MARKET QUOTATIONS.

Wednesday, November 28th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	„ Nitric	per cwt.	22/-	..
a	„ Oxalic	per cwt.	32/-	..
a	„ Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	„ „	per ton	£30	..
a	Bleaching powder	per ton	£5 10	..
a	Bisulphide of Carbon	per ton	£18	..
a	Borax	per ton	£15	..
a	Benzole (90 %)	per gal.	10½d.	..
a	„ (50 %)	per gal.	1/-	..
a	Copper Sulphate	per ton	£31 10	..
a	Lead, Nitrate	per ton	£31	..
a	„ White Sugar..	per ton	£35	..
a	„ Peroxide	per ton	£32	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a	Potassium Bichromate, in casks	per lb.	5½d.	..
a	Potash, Caustic (75/80 %) ..	per ton	£30	..
a	Potassium Cyanide	per lb.	8½d.	..
a	Shellac	per cwt.	220/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	„ Recovered	per ton	£5 10	..
a	„ Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	„ Crystals	per ton	£8 5	..
a	Sodium Bichromate, casks ..	per lb.	3d.	¼d. inc.
a	„ Cyanide	per lb.	7½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£200	..
b	„ Wire, in ton lots ..	per ton	£220	..
b	„ Sheet, in ton lots ..	per ton	£210	..
p	Babbitt's metal ingots	per ton	£62 to £207	inc.
c	Brass (rolled metal 2" to 12") basis	per lb.	11¼d.	⅛d. inc.
c	„ Tube (brazed)	per lb.	1/0¾	⅛d. inc.
c	„ „ (solid drawn).. ..	per lb.	1/-	⅛d. inc.
c	„ Wire, basis	per lb.	11d.	⅛d. inc.
c	Copper Tubes (brazed)	per lb.	1/2½	¼d. inc.
c	„ „ (solid drawn) ..	per lb.	1/2½	¼d. inc.
g	Copper Bars (best selected) ..	per ton	£117	£2 inc.
g	Copper Sheet	per ton	£117	£2 inc.
g	„ Rod	per ton	£117	£2 inc.
e	„ (Electrolytic) Bars ..	per ton	£106 10	40/- inc.
e	„ „ Sheets ..	per ton	£119	50/- inc.
e	„ „ Rod ..	per ton	£110	£3 inc.
e	„ „ H.C. Wire	per lb.	1/1	¼d. inc.
f	Ebonite Rod	per lb.	8/8	..
f	„ Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/8	..
h	Gutta-percha, fine	per lb.	6/- to 7/-	..
h	India-rubber, Para fine	per lb.	5/0½ to 5/2½	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	„ Pig (Cleveland warrants)	per ton	60/1½	3/4½ inc.
i	„ Forgings, according to size	per ton	From £11	..
i	„ Scrap, heavy	per ton	47/6 to 50/-	..
i	„ Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£19 12 6 to £19 15	2/6 dec.
g	„ „ Sheet	per ton	£21 12 6 to £21 15	2/6 dec.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d	„ „ „ medium	per lb.	2/6 to 4/-	..
d	„ „ „ large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/4 to 1/6	inc.
p	„ rolled bars & rods	per lb.	1/5 to 1/6	½d. inc.
p	„ „ strip & sheet	per lb.	1/5½ to 1/9	inc.
o	Platinum	per oz.	nominal	..
	Silicium Bronze Wire	per b.	1/2½	inc.
	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
	„ „ in bars		£15 to £40	..
g	Tin, Block (English)	per ton	£198 to £199	£2 inc.
n	„ Wire, Nos. 1 to 16	per lb.	2/4	..
p	White Anti-friction Metals—			
	"White Ant" brand	per ton	£61 to £68	inc.
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£32 15	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
e Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Bombay Electric Supply and Tramways Co. Ltd.—60,000 6 per cent. cumulative preference shares of £10 each, £6 paid, Nos. 15 to 60,000 and 119,987 to 120,000; and £600,000 4½ per cent. debenture stock.

Mexican Electric Light Co., Ltd.—$6,000,000 5 per cent. first mortgage gold bonds, Nos. C1 to C1,000 for $100 each, D1 to D3,000 for $500 each, and M1 to M4,400 of $1,000 each.

Mexican Light and Power Co., Ltd.—$13,650,000 capital stock in shares of $100 each; and $12,000,000 5 per cent. first mortgage gold bonds, Nos. 1 to 4,000 for $500 and 4,001 to 14,000 of $1,000 each.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended October 26th, 1906, were 511,539 compared with 358,193 units in the corresponding four weeks of the preceding year.

STOCKS AND SHARES.

Tuesday Afternoon.

Investment markets continue to be dominated by the stiff money which results from the 6 per cent. Bank Rate. New undertakings are cold-shouldered by a public which declines to look at securities paying less than 5 per cent. on the money, combined with safety. The older issues are not supported, and the consequence is that when sellers come to market, the offer of comparatively few shares brings about a drop in the price out of proportion to the number of shares, or the amount of stock, that it is sought to realise.

Publication of the London County Council criticisms upon the methods of book-keeping adopted by some of the electricity supply companies has not made any difference to prices in this department. Of course, the weak spots have been known to all students of the market for a long time past. The ratio of profit that should be applied annually to depreciation is a subject that has frequently been mentioned here; it is not long ago since we showed in a significant table how the various companies treated this important item in their accounts. The electricity supply market remains in a state of suspended animation, with changes few and far between.

County of London Preference declined 10s. to 11, and Metropolitan Ordinary ⅛ to 8. The latter company's Preference, however, are $\frac{1}{16}$ higher at $5\frac{5}{16}$. Notting Hill Debentures and Urban Debenture both rose a point. There was a small inquiry for Smithfield Ordinary, which advanced the price ¼ to 1¾. At 30s. Brush Preference are rather harder.

Notwithstanding the unofficial assurances that none of the late Mr. Herring's holdings would be allowed to trouble markets in any way, the appearance of a seller of securities, such as Mr. Herring was known to be interested in, is regarded suspiciously.

British Electric Traction Preference are better at 8⅜, and the traction department is fairly steady altogether. Anglo-Argentine Trams are $\frac{1}{16}$ firmer; the Belgrano Ordinary fell ¼. A very poor report sent Cape Electric Trams to 10s., and the market—except for buyers—has become more or less nominal. British Columbia Deferred has recovered all its dividend.

None of the electrical railway stocks show much change. Central London Preferred is a point harder at 99, but City and South London shed its small increase of last week, slipping back to 42. Districts are down to 20. The official recommendations, with respect to motor-omnibus regulations, had the effect of advancing Metropolitan Railway Consolidated to 64, after the price had fallen slightly. "Vanguard" shares, by the way, are $1\frac{1}{16}$ for the Ordinary, and 3⅜ for the £5 fully paid Preference shares, the latter carrying a 6 per cent. cumulative dividend. There is very little public confidence in motor-omnibus shares of any sort.

While upon the subject of 6 per cent. Preference shares, it is worth noticing that Bruce Peebles Preference are $\frac{3}{16}$ lower at $4\frac{1}{16}$ for a reason similar to that set forth in the opening paragraph above. And, to continue the same subject, several bargains have been marked within the last few days in Willans & Robinson 6 per cent. Cumulative Preference shares, which have gone dividend-less since October, 1903. The price of 46s. 10½d., at which bargains are being marked, therefore carries 3s. 7½d. interest, and although the purchasers can scarcely hope to see cash payment of all the arrears, something will have to be done to satisfy them directly the company turns the corner of its long lane of adversity. Evidently there are some who consider that the turning-point is not far away.

Other manufacturing shares are somewhat dull. Henley's are ¼ lower, and so are Callender's. Castner-Kellner at 1⅛ have regained the small loss registered a week ago.

Five out of the seven issues of the National Telephone Co. are lower on balance, the falls being no more than ⅛ on the stocks. Anyone who bought upon the *Daily Mail's* immature announcement as to alteration in the company's methods of subscription must be wishing he had followed the caution held out here with regard to the value of such "news." Oriental Telephone Preference at $1\frac{3}{16}$ are easier.

West India and Panama Telegraph shares pursue their upward path with vigorous persistency. All the share issues are again higher. In saying this, one comes to practically the end of the story, because other telegraph descriptions have varied so little. Anglo-Americans are slightly irregular. Direct United States rose to 16. Globe Preference and Ordinary gave way ⅛ at 14⅜ and 10⅝ respectively. There is a point fall in Commercial Cables certificates.

Simultaneous publication by several leading papers of a re-hash of the Victoria Falls electric power scheme has excited the mildest of interest in the Stock Exchange. The house is very sceptical of this plan for supplying the Rand with electric power. Every now and again the imposing details are trotted out with an air as though they were something quite new, which of course the main ideas of the scheme are certainly not. The investor will do well to confine his attention purely to the technical side of the enterprise.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Nov. 20th.	Closing Quotations Nov. 27th.	Business done week ended Nov. 27th, 1906. Highest	Lowest.	Rise + or Fall —
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	2¼ — 3⅜	2¼ — 3⅜	..	..	..
155,600	Do. do. 5 % Debs., Nos. 1 to 1,200 Red.	100	Nil	Nil	Nil	5 %	88 — 93	84 — 93	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	22½	3½	65½ — 67½	66 — 68	66½	..	+ ½
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½ %	6 %	109 —110	109 —110	110	109½	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½	262— 27	262— 26⅝	26⅛	26⅛	— ⅜
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101½—103½	..	..	+ ½
44,000	Chili Telephone, Nos. 1 to 44,000	5	..	..	..	..	6⅜— 7⅛	6⅜— 7⅛	..	..	..
1,992,866	Commercial Cable Sing. 500 year 4 % Deb. Stk. Red.	Stock	6 %	7 %	8 %	8 %	97 — 99	97 — 99	98½	97½	..
16,000	Cuba Telegraph	10	6¼ %	10 %	5 %	5 %	8¼ — 9	8¼ — 9	8⅝	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	10 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¼ — 9⅜	8¼ — 9⅜	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½ %	4½ %	4½ %	4½ %	99½—102½	99½—102½	..	..	..
80,710	Direct United States Cable	20	8½ %	8 %	8½ %	4½ %	15⅝— 16	15⅝— 16⅛	16⅛	15⅞	+ ⅛
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½ %	4½ %	4½ %	4½ %	100½—102½	100½—102½	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	138 —141	137 —140	140	137½	—1
2,000,000	Do. 5½ % Pref. Stock	100	5½ %	5½ %	5½ %	5½ %	90 — 92	90 — 92	90½	..	..
1,248,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	105½—107½ xd	105½—107½xd	107	106	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13⅝ — 13¾	13⅝ — 13⅞	13⅞	13⅞	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½—107½	105½—107½	107½	..	..
500,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½ %	5⅝ %	5½ %	10⅝— 10¾	10½— 10⅝	10⅜	10⅜	— ⅛
180,887	Do. do. 8 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 14⅝	14⅜— 14½	14⅜	..	— ⅛
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½ %	15 %	24 %	24%	36 — 38	36 — 38	37½	..	..
87,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	58½— 60½	58½— 60½	..	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛— 1⅛	1⅛— 1⅛	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	5 %	1⅛— 1⅛	1⅛— 1⅛	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅞— 1	⅞— 1	..	..	..
1,983,338	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	107½—109½	109½	107½	— ½
1,966,667	Do. do. Def. Stock	100	4½ %	5 %	5 %	5 %	108 —110	107 —109	108½	107½	—1
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½— 12½	10½— 12½	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	..	— ⅛
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½ %	3½ %	3½ %	3½ %	98 —100	97½— 99½	98	97½	— ½
1,889,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	100½—102½	101⅞	101½	— ½
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6 %	6½ %	7½ %	1½ — 1⅝	1½—1⅝	25/-	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅜— 1⅝	1⅜— 1½	..	..	—1/16
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	99 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7½— 7⅝	7½— 7⅝	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½ %	101 —104	101 —104	..	..	..
8,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	126 —129	..	..	—1
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	6⅞— 7⅛	6⅞— 7⅛	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5½— 5⅝	5½— 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —113	110 —113	..	..	..
15,609	West African Telegraph, Shares	10	2 %	4 %	4½ %	4 %	10 — 10½	10 — 10½	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2½	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100½—103½	100½—103½	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	7 %	14 — 14½ xd	14 — 14¼xd	14⅜	14⅛	..
568,890	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..
88,821	West India and Panama Telegraph	10	Nil	Nil	Nil	..	1⅛— 1⅜	1⅛— 1⅜	14/6	11/3	+1/16
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	Nil	8 — 8½	8⅛— 8⅜	..	..	+ ⅛
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	5½— 6½	5⅜— 6⅜	..	..	+ ⅛
80,000	Do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	5 %	5 %	101 —104	101—104	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,608 to 580,007	5	..	..	8 %	8 %	7⅛— 7⅜	7 7/16— 7 15/16	7 7/8	7½	+ 5/16
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5½— 6	5⅜— 6	5 29/32	5½	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	139 —142	139 —142	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	105	..	..
800,000	Babcock & Wilcox, 1 to 680,000	1	..	17 %	20 %	20 %	3⅞— 4⅛	3⅞— 4⅛	78/9	..	..
100,000	Do. do. 5 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 7/16— 1 9/16	1 7/16— 1 9/16	..	..	..
58,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	5⅝— 5⅞	5⅝— 5⅞	..	..	..
40,000	Do. do. 7 % Cum. Pref.	5	Nil	Nil	7 %	7 %	6¼— 6½	6¼— 6½	6⅝	6½	..
50,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼— 5½	5¼— 5½	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4½	4 — 4½	20/-	..	..
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —105	101 —105	102½	..	..
100,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	..	100 —103	100 —103	..	..	..
600,000	British Columbia E. Rail Def. Ord. Stock ..	100	..	6 %	6 %	6 %	124 —129 xd	125 —130	128⅜	127⅜	+1
600,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —115	110 —115	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	108 —111	108 —111	108½	..	..
240,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½ %	4½ %	4½ %	102 —105	102 —105	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
128,201	British Electric Traction	10	3 %	6 %	6 %	3 %	4½— 4⅝	4½— 4⅝	..	..	..
161,457	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	8 — 8½	8¼— 8⅜	8 7/16	8 5/16	+ ⅛
1,115,429	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	104 —107	105 —108	106½	106½	+1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½ %	4½ %	85 — 88	85 — 88	..	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅜— 6⅝	6⅜— 6⅝	6 7/8	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6⅛	5⅝— 6⅛	5⅞	..	..
600,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	103	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	..	4½%	4½%	4½%	94 — 98	94 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1 — 1½	1 — 1½	..	..	..
1,716,858	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	75 — 79	75 — 79	..	..	..
£0,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	13/6 to 15/6	14/6 to 15/6	..	..	..
80,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	13/6 to 15/6	14/6 to 15/6	..	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	Nil	2½%	¾— 1	¾— 1	18/9	..	..
180,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1⅛— 1⅜	1¼— 1⅜	30/-	27/6	+ ⅛
156,000	Do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	95 — 97	95 — 97	..	..	..
126,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 85	82 — 85	82½	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000 ..	5	..	3 %	4 %	3 %	3 — 3½	2⅞— 3⅛	62/6	..	— ⅛
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅞— 5⅛	4⅞— 5⅛	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107	105 —107	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	7⅞— 8⅛	7⅞— 8⅛	..	..	+ ⅛
82,610	Do. 105,001 to 187,610	5	..	..	..	8 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..
29,330	Do. 5 % Cum. Pref., Nos. 1 to 29,330	..	..	..	..	..	5¼— 5⅜	5¼— 5⅜	5⅜	5⅛	..
850,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	104⅜	..	..
95,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10 — 11	9½— 10⅜	10	..	— ½
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	6⅜— 5⅞	5⅜— 5⅛	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108½—110½	108½—110½	..	..	..
491,223	Cape E. Trams., 1 to 491,223	1	15 %	10 %	5 %	Nil	⅛— ⅜	1/16— 1/16	11/3	10/-	— 1/16
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1⅜— 1⅝	1⅜— 1⅝	29/1½	..	..
220,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1 989,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	88 — 85	83 — 85	84	83½	..
680,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	97 — 99	98 — 100	99	98½	+1
680,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	72 — 75	73 — 75	74	74	+ ½
1,'20,000	City and South London Railway	Stock	2½ %	2½ %	2½ %	12½ %	42 — 44	41 — 43	43	42	—1
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	2½ %	2½ %	2½ %	1½— 1⅝	1½— 1⅝	..	..	..
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 500 of £160, and 501 to 11,000 of £80 Red.	..	5 %	5 %	5 %	5 %	94 — 97	94 — 97	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(Continued)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(continued).

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Nov. 20th.	Closing Quotations Nov. 27th.	Business done week ended Nov. 27th, 1906. Highest.	Lowest.	Rise + or Fall—
		†									
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	10 %	1 7/16 — 1 1/8	1 7/16 — 1 1/8	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1 1/8 — 1 1/4	1 1/8 — 1 1/4	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,361	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,361	5	Nil	Nil	2 1/2 %	4 1/2 %	1 1/4 — 1 3/8	1 1/4 — 1 3/8	..	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2 1/2 %	4 1/2 %	2 1/4 — 2 1/2	2 1/4 — 2 1/2	..	..	..
844,028§	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	£6 — 88	86 — 88	..	..	..
100,000§	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	7/16 — 7/16	3/8 — 3/8	5/-	..	— 1/32
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	7 %	1 1/8 — 2	1 1/8 — 2	..	..	..
205,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	83 — 86	83 — 86	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	9 — 9 1/2	9 — 9 1/2	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	91 — 94	91 — 94	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3 1/2 — 3 3/4	3 1/2 — 3 3/4	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10 1/2 — 10 3/4	10 1/2 — 10 3/4	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —103	102 —103	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15 %	12 — 13	11 3/4 — 12 3/4	12	..	— 1/4
900,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5 1/4 — 5 3/8	5 1/4 — 5 3/8	..	..	..
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	108 —110	108 —110	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10 %	5 %	10 %	17 — 18	17 — 18	17 3/4	..	..
87,500	‡Liverpool Overhead Railway, Ord.	10	1 1/2 %	1 3/4 %	1 3/4 %	Nil	1 3/8 — 1 5/8	1 3/8 — 2	..	..	+ 3/8
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	5 — 6	7 — 8	..	..	+1
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 8 1/2	7 — 9	..	..	— 1/2
899,930	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	8 1/2 — 4 1/2	3 1/4 — 4 1/2	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8 — 9	8 — 9	8 7/16	8 1/2	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	90 — 95	90 — 95	..	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Ni	Nil	Nil	3 %	1/16 — 3/16	1/16 — 3/16	2/-	1/3	..
600,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	13/16 — 15/16	13/16 — 15/16	16/6	16/3	..
850,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½ %	4½ %	97 —100	97 —100	..	..	..
150,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	..	6 %	6 %	4 3/8 — 5	4 3/8 — 4 7/8	..	..	— 1/16
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6 1/2 — 7 1/2	6 1/2 — 7 1/2	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7 1/2 — 8 1/2	7 1/2 — 8 1/2	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	98 1/2 —101 1/2 xd	98 1/2 —101 1/2 xd	..	..	..
87,850	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	31 1/2 — 33 1/2	31 1/2 — 33 1/2	..	..	..
150,000§	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
8,599,300	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	90 — 92	90 — 92	91	90	..
640,000	Waterloo & City Railway, Ord. Stock	100	3½ %	3½ %	3½ %	3½ %	99 —102	99 —102	..	..	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	5	8½ %	3 %	Nil	Nil	3/4 — 1 1/4	3/4 — 1 1/4	..	..	..
66,666	Do. 6 % C. P., 80,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2 — 2 1/4	2 1/4 — 2 1/2	48/9	46/10 1/2	+ 1/2
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	75 — 80	75 — 80	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5 1/2 %	4 %	5 — 5 1/2	5 — 5 1/2	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½ %	4½ %	4½ %	99 —101	99 —101	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8 1/2 — 8 3/4	8 1/2 — 8 3/4	8 1/4	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 7/8 — 8	7 7/8 — 8	..	..	..
800,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	3 1/4 — 4 1/2	3 1/4 — 4 1/2	..	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½ %	4½ %	4½ %	4½ %	4 1/2 — 5	4 1/2 — 5	50/-	..	..
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½ %	4½ %	4½ %	4½ %	3 3/4 — 4 1/4	3 3/4 — 4 1/2	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
44,486	Chelsea Electricity Supply, Ord.	5	4½ %	5 %	6 %	6 %	5 1/8 — 5 3/8	5 1/8 — 5 3/8	..	..	..
175,000§	Do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	4½ %	106 —109	106 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	9 1/4 — 10 1/2	9 1/4 — 10 1/2	9 3/4	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	11 — 12	..	..	..
400,000§	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	125 1/4	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½ %	4½ %	4½ %	4½ %	100 —103	100 —103	100 1/4	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2 1/16 — 3 3/16	2 1/16 — 3 3/16	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5 3/8	5 — 5 3/8	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 1/2 %	5 %	8 1/2 — 8 3/4	8 1/2 — 8 3/4	8 1/4	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11 1/2 — 1 1/2	10 1/2 — 11 1/2	..	..	— 1/2
400,000§	Do. do. 4½ % Deb. Stock	..	4½ %	4½ %	4½ %	4½ %	107 —110	107 —110	108	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	100 —102	99 —102	..	..	— 1/2
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	2 3/8 — 3 1/4	2 3/8 — 3 1/4	60/-	58/9	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4 1/2 — 5 1/2	4 1/2 — 5 1/2	..	..	..
820,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½ %	4½ %	4½ %	4½ %	99 —102	99 —102	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5 %	5 %	5 %	5 1/8 — 5 5/8	5 1/8 — 5 5/8	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	4 1/8 — 5 3/8	4 1/8 — 5 3/8	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½ %	4½ %	4½ %	99 —102	99 —102	..	..	..
18,000	Hove, 1 to 18,000	5	..	8½ %	8½ %	9 %	8 — 8 1/4	7 3/4 — 8 1/4	8 1/8	8	— 1/4
10,000	Do. New (£6 10s. paid)	£8	..	8½ %	8½ %	9 %	6 1/4 — 6 3/4	6 3/4 — 7 1/4	..	..	+ 1/8
87,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	96 — 99 xd	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	96 — 99	96 — 99 xd	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12 %	12 %	10 %	9 3/4 — 10 1/4	9 3/4 — 10 1/4	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	1 1/2 — 2 1/4	1 1/2 — 2 1/4	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4 1/2 — 5 1/4	4 1/2 — 5 1/4	5 1/16	5 1/16	..
674,396	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½ %	8½ %	10 %	10 %	7 3/4 — 8 3/4	7 3/4 — 8 1/4	7 3/4	..	— 1/4
76,121	Do. 4½ % Cum. Pref. 1—71,106, £8 pd.	5	4½ %	4½ %	4½ %	4½ %	5 1/8 — 5 3/8	5 1/16 — 5 1/16	5 1/16	..	+ 1/16
220,000§	Do. 4½ % 1st Mort. Deben. Stock	..	4½ %	4½ %	4½ %	4½ %	109 —113	109 —113	..	..	..
250,000§	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½ %	3½ %	3½ %	3½ %	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	99 1/2	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7 3/4 — 8	7 3/4 — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5 %	5 %	5 %	5 3/8 — 6 1/8	5 3/8 — 6 1/8	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7 1/2 %	13 1/2 — 14 1/2	13 1/2 — 14 1/2	..	..	..
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	96 — 98	97 — 100	..	..	+1 1/2
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6 1/2 %	7 %	7 %	6 1/8 — 6 3/8	6 1/8 — 6 3/8	..	..	..
60,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14 1/2 %	14 1/2 %	14 1/2 %	12 1/2 %	9 3/4 — 10 1/4	9 3/4 — 10 1/4	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000§	Do. do. 3½ % Deb. Stock Red.	100	3½ %	3½ %	3½ %	3½ %	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½ %	4 %	4 %	4 %	1 — 2	1 1/4 — 2 1/4	..	..	+ 1/4
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½ %	8 %	4 %	4 %	2 3/4 — 3 1/4	2 3/4 — 3 1/4	..	..	..
121,100	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	Nil	2 1/2 %	1/16 — 1/16	1/16 — 1/16	12/6	..	..
117,948	Do. Do. 7 % Pref.	1	Nil	7 %	7 %	7 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	102 —105	102 —105	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3 — 3 1/2	3 — 3 1/2	..	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4 1/4 — 4 1/2	4 1/4 — 4 1/2	..	..	..
90,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½ %	4½ %	97 —100	98 —101	99 1/2	..	+ 1
110,000	Westminster Electric Supply, Ord.	5	12 %	13½ %	14 %	13 %	9 1/2 — 10 1/2	9 1/2 — 10 1/2	9 15/16	9 3/8	..
98,151	Do do. 4½ % Cum. Pref. (Originally 5%- Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	5 %	5 1/2 — 5 3/4	5 1/2 — 5 3/4	5 7/16	5 3/8	..

Shares not officially quoted:—Mackay Companies, ord., 73—75. Pref. 72—74.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 6 per cent. October 19th. 1906.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING NOVEMBER, 1906.

The October returns of electrical business show a marked upward tendency in comparison with preceding months, the values of the exports and imports being some £40,000 and £30,000 to the good, as compared with the September returns.

Actually, the exports reached £146,361, a figure which has only once been exceeded during 1906, and which compares with £109,102 in the corresponding month of last year. The imports at £167,337 also reached a very high level, and exceeded by some £37,000 the value for the corresponding month of 1905. The re-exports at £16,001 compare with £18,677 in the month of September, and with £9,871 in October, 1905.

Taking the past two years' returns as a whole, we have every reason to congratulate ourselves on the improving business which they indicate.

Of the individual items, the exports of cable show an increase of some £27,000 over the September value, while the exports of electrical and electrically-driven machinery maintain their usual high level; the imports of telephonic and telegraphic material are somewhat higher than in the preceding month, Belgium and Sweden, as usual, contributing between them the lion's share.

Our Indian, South African and Australian Colonies, with the South American States were, as usual, the most prominent purchasers of home products.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	686	176	130	...	87	693	87	...	...	73	...
Germany	229	61	38	8	26	344	10	...	130	...	...
Netherlands and Dutch Guiana	78	1,247	343	...	...	97	...	...	...	89	...
Belgium	189	43	70	15	27	215	...	...	1,094	423	...
France and French Indo-China	82	...	106	129	...	138	65	10	...	450	...
Portugal, Madeira and Portuguese Africa ...	1,415	505	41	23	123	1,736	86	...	32	36	...
Spain, Canary Isles and Spanish-African Ports...	...	...	26	7	38	257	120	2	...	14	...
Italy and Austria-Hungary	36	30	25	...	10	376	90	...	...	...	...
Greece, Bulgaria and Roumania	...	...	...	...	32	52	44	...	...	...	...
Egypt, Tunis and Cyprus	794	227	304	16	4	197	...	...	9	6,621	...
China and Siam	998	1,847	902	96	...	385	52	...	...	...	...
Japan	188	3,184	4	...	1,425	899	40	...	400	6,169	...
U.S.A., Cuba and Philippines	...	...	...	998	20	314	2	17	...	...	...
Nicaraqua, Ecuador and Colombia	2	30	47	5	...	39	3	...	...	...	...
Peru and Uruguay	74	...	87	...	...	40	...	...	23	...	...
Chili	437	...	621	24	...	596	34	...	...	40	...
Brazil	68	1,203	360	114	...	1,400	48	4	27	...	...
Argentine	1,664	12,554	361	69	...	1,046	641	...	488	2,086	...
Channel Isles, Gibraltar and Malta	1,234	4,871	543	72	64	416	...	...	...	2,105	...
British West Africa and St. Helena	22	...	...	...	...	87	...	...	...	11	...
Cape of Good Hope	2,277	1,431	270	311	44	245	121	32	99	44	...
Natal	729	2,980	416	251	20	890	26	39	...	23	...
Zanzibar, Brit. East Africa, Mauritius and Aden	81	300	34	98	4	...	33	...	169	...	...
India	2,719	11,511	1,677	1,469	685	4,513	304	79	178	1,732	191
Burmah	340	1,268	103	154	16	779	8	...	18	111	...
Ceylon	26	34	26	93	49	200	15	...	87	...	...
Straits Settlements, and Sarawak	371	144	438	193	126	5	6	36	20	234	...
Hong Kong	226	35	159	74	...	39	5	...	117	530	...
West Australia	154	...	41	88	143	894	162	7	...	45	...
South Australia	1,210	150	142	...	...	...	100	...	...	...	...
Victoria	2,637	2,813	149	211	114	745	7	...	88	193	...
New South Wales	2,178	3,398	687	741	404	2,202	249	114	162	96	...
Queensland	135	...	81	...	...	...	...	...	51	...	...
Tasmania	75	...	18	...	...	5	15	...	...	...	...
New Zealand	529	1,754	686	31	86	3,675	297	...	398	96	...
Canada and Bermudas	368	55	111	145	...	870	721	...	...	...	...
British West Indies, British Guiana and Falkland Islands	108	...	103	80	...	326	73	...	48	...	...
Total, £	22,359	51,851	9,449	5,515	3,547	24,715	3,464	340	3,638	21,221	191

Additional Exports: Persia, Electrical Apparatus, £3; Mexico, Electrical Machinery, £68.

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark	54	236	...	60	...	2,462	162	...	12,867	...	...
Holland	1,229	4,132	1,404	10,669	412	1,650	190	3,582	844	...	...
Germany	2,884	18,034	1,305	2,259	44	8,664	708	721	1,446	9	...
Belgium	823	4,501	193	6,090	388	6,267	258	1,562	15,732	10,352	...
France	790	6,679	1,282	2,989	1,254	1,298	645	3,784	...	34	...
United States	3,655	490	978	9	...	18,363	39	89	10	2,627	...
Total, £	9,435	34,072	5,162	22,076	2,098	38,704	2,002	9,738	30,899	13,022	...

Additional Imports: Italy, cable, £15; Victoria, goods, £100; Canada, motors, £14.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	7,230	105	219	85	116	553	247	222	7,138	66	40

Total Exports: £146,361

Total Re-Exports: £16,001

Total Imports: £167,337

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

DESIGN COEFFICIENTS FOR DYNAMO-ELECTRIC MACHINES.

By H. M. HOBART and A. G. ELLIS.

(*Concluded from page* 847.)

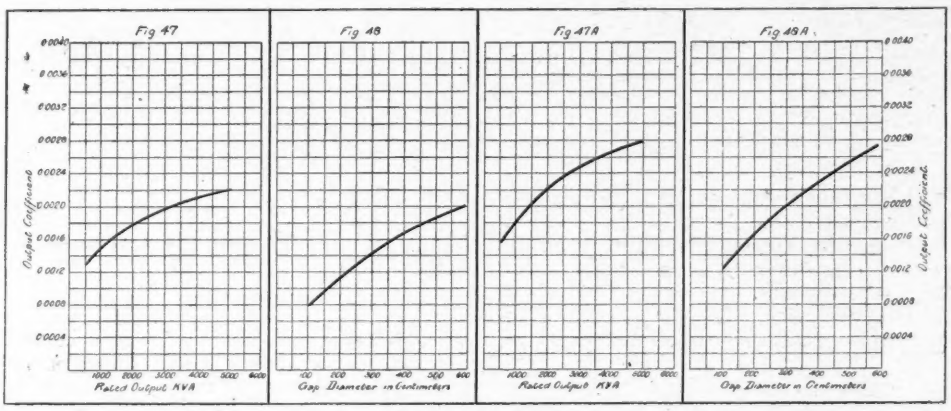
III.—Output Coefficient of Alternators.

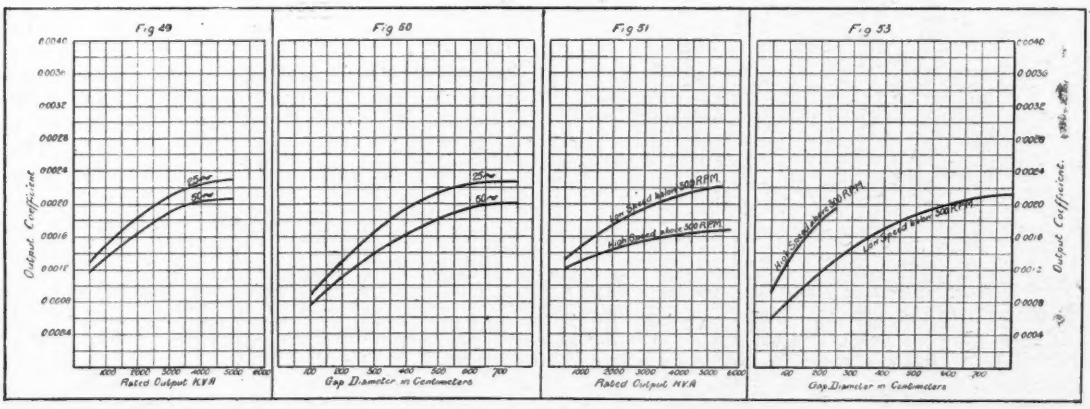
The curve in fig. 47 shows the relation between the average output coefficient and the rated output of polyphase alternators. The data from which this curve is drawn are chiefly for low-speed machines, and the curve should be taken as representative for low and moderately low-speed alternators. The question of the influence of high speeds is considered further on.

Fig. 48 shows the relation between the average output coefficient and the air-gap diameter for low-speed and moderately low-speed alternators. Figs. 47A and 48A are similar to figs. 47 and 48, but the curves shown in these figures indicate the highest values of the output coefficient which have been obtained on a few recent alternators. It is not difficult to obtain good designs with output coefficients as high as those indicated by these two curves, but as the curves of figs. 47 and 48 represent the bulk of the designs from which this analysis has been made, they will be considered as representative values, and the further studies in this article will have reference to figs. 47 and 48.

The curves of figs. 47 and 48 should be taken as mean curves for machines over the average range of frequency, and the influence of the latter on the possible output coefficient has been studied in figs. 49 and 50. Fig. 49 gives two curves for 25 and 50-cycle alternators respectively, showing the output coefficient plotted against the rated output. It will be noted that somewhat higher output coefficients are obtainable with lower frequencies, as was the case with induction motors (see fig. 32). Fig. 50 shows similar curves plotted against the air-gap diameter for 25 and 50-cycle machines.

Regarding the influence of the speed, although the weight of the machine is considerably reduced by the employment of high speeds (the weight being an inverse function to the speed for a given rated output), it is not, however, the case that high speeds permit of higher output coefficients. On the contrary, the output coefficients obtained with steam turbine alternators are considerably lower than with slow speed, which point is further borne out by inspection of a number of recent turbo-alternator designs. This is due to the fact of the design of alternators for high speeds being a difficult problem in itself, and larger amounts of material, and, consequently, larger dimensions, are called for by the mechanical problems and the question of heating.





Output Coefficient Curves for Alternators.

In fig. 51 the upper curve is reproduced from fig. 47, and is marked for low-speed machines, say, below 300 R.P.M. The lower curve indicates the average output coefficients for high-speed machines above 300 R.P.M. and up to a maximum of 1,500 R.P.M.

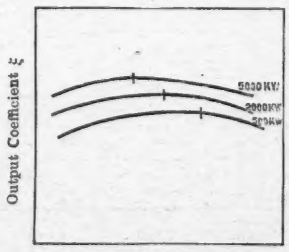


Fig. 52.

The low output coefficients for the high-speed machines are apparent from these curves. In smaller ratings the curves more nearly approach one another, as the high speeds are more favourable to small machines than to machines of la

rating. It is probable that there is a certain speed for each rating to which the design is most favourable, and at which speed the output coefficient will be greatest and the weight a minimum. This speed would be greater the lower the

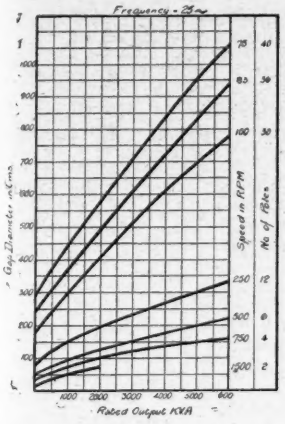


FIG. 54.

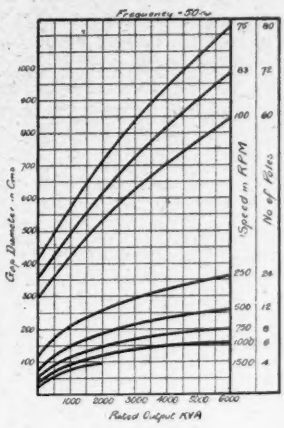


FIG. 55.

AIR-GAP DIAMETER AND RATED OUTPUT FOR VARIOUS SPEEDS.

rated output, and for a different number of rated outputs the relation between the output coefficient and the speed may be taken somewhat as indicated in the curves of fig. 52. These curves do not profess to be quantitatively correct, but only indicate the tendencies.

In fig. 53 the output coefficient is shown as a function of the air-gap diameter for high and low speeds. The high-

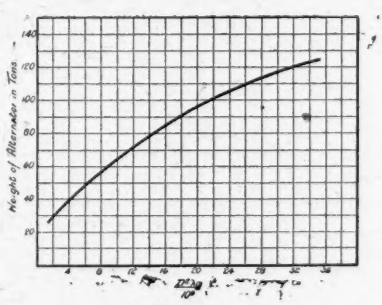


FIG. 56.

speed curve, it will be seen, is above the low-speed, and it may be thought at first sight that this is contradictory to the curves in fig. 51. This is not the case, but the fact is that for a given diameter the high-speed machine has a

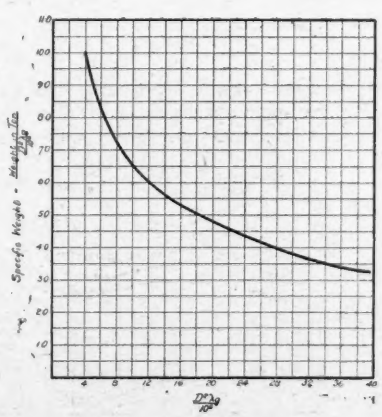


FIG. 57.

higher output coefficient than the low-speed; this is because for any given diameter, the high-speed machine would have a rated output of several times that of the low-speed. Thus, for example, consider a 3,000-K.V.A. machine designed first for a speed of 100 R.P.M., and secondly, for 1,000 R.P.M. At 100 R.P.M. the output coefficient, according to the upper curve of fig. 51, would be about 0·00195; and at 1,000 R.P.M., from the lower curve of fig. 51, the output coefficient would be 0·00155.

In such a pair of machines as designed, the air-gap diameter would be about—

600 cm. for the 100 R.P.M.,

and 150 „ „ 1,000 „

Now, from the curves of fig. 53 the output coefficients corresponding to these diameters are respectively—

0·0020 for the low speed 600 cm. diameter,

and 0·0016 „ high „ 150 cm. „

These figures are in good agreement with those obtained from the high and low speed curves of fig. 51.

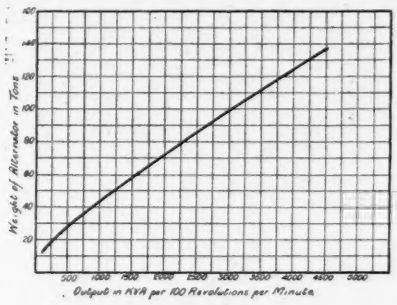


FIG. 58.

In figs. 54 and 55 is given a set of curves showing the gap diameter as a function of the rated output for various stated speeds. Fig. 54 relates to 25-cycle machines and fig. 55 to 50-cycle machines. The number of poles at once follows from the speed and frequency, and this has been noted on each curve with the speed.

These curves may be taken as a basis for determining preliminarily the most suitable diameter to employ for a machine of given rated output, speed and frequency. Having thus determined the diameter, the output coefficient is taken from the curves in figs. 47 to 54, from which the armature core length can now be determined, and thus the main dimensions for the machines are settled.

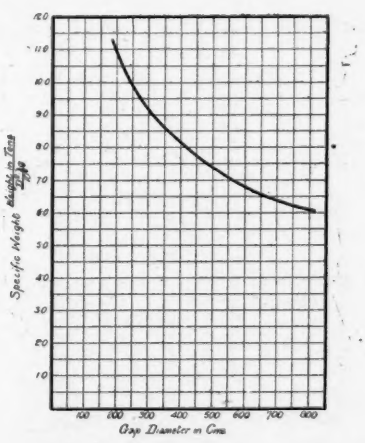


FIG. 59.

Weight Coefficients of Alternators.—Figs. 56 to 60 show the results of investigation of the total weight of polyphase alternators.

The weight in all cases is the total weight of stator and rotor, not including bed-plate, shaft and bearing pedestals. The weights are all expressed in metric tons (1 metric ton = 1,000 kg. = 2,200 lb. approximately). Fig. 56 shows the relation between the weights in tons and the value of $D^2 \lambda g$, which latter is proportional to the volume of the armature. This curve will hold for both low and high speeds, as the weight of the pole spider or fly-wheel in the former is counterbalanced by the extra

weight of the armature laminations in the latter, due to their necessarily large radial depth. Thus for a given value of $D^2 \lambda g$ the total weight of the machine will be roughly the same for high and low-speed machines.

Fig. 57 shows the relation between the "specific weight," *i.e.*, the weight per unit of $D^2 \lambda g$, and the value of $D^2 \lambda g$, derived from fig. 56.

Fig. 58 shows the relation between the weight and the rated output in K.V.A. per 100 R.P.M.

Fig. 59 shows the relation between the "specific weight" and the air-gap diameter D.

Fig. 60 gives the relation of the weight per K.V.A. output to the rated output for three different speeds of 100, 200 and 1,000 R.P.M.

Other speeds can be readily interpolated. The influence of speed on the weight will be observed from these curves.

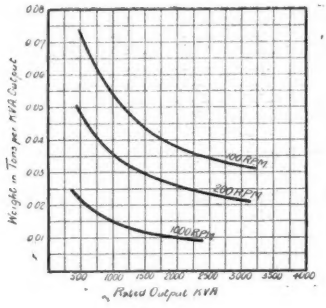


Fig. 60.

It will also be noted that the weight per K.V.A. increases considerably in the smaller ratings. That this should be so is borne out by the curves of output coefficient above, where it will be seen that the machines of smaller rating have considerably lower output coefficients, and consequently a greater amount of material per K.V.A.

In fig. 61 we have brought together the curves of figs. 27 and 56, which give the weight of large continuous-current dynamos and alternators as a function of $D^2 \lambda g$, *i.e.*, of the air-gap dimensions. From this figure it will be seen that the weight of a continuous-current generator of given air-gap dimensions is some 30 per cent. greater than an alternator of the same air-gap dimensions.

This is due in great part to the presence of the commutator in the continuous-current machine, as, apart from the commutator, the amounts of active iron and copper are very much of the same order in both classes of machine.

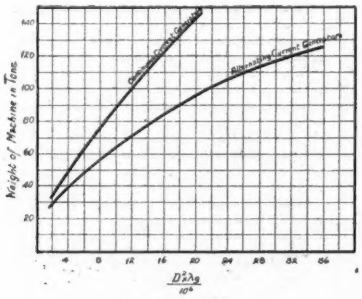


Fig. 61.

Fig. 62 shows a similar comparison between smaller continuous-current motors (or dynamos) and alternating-current induction motors, the curves of figs. 26 and 45 having been brought together here. The percentage difference between the weights of these two classes of machine is much greater than is the case in fig. 61, the weight of a continuous-current motor appearing some 100 per cent. greater than that of an induction motor having the same value for $D^2 \lambda g$, *i.e.*, the same volume of armature.

This larger difference is due to the material being much more concentrated at the air gap periphery in the case of induction motors than in continuous-current machines.

In an induction motor the external diameter is only of the order 1·25 to 1·75 times the air-gap diameter, whereas in continuous-current machines it is more of the order 1·5 to 2 times the air-gap diameter.

In the latter case, there is thus a large amount of the material located at a mean diameter much larger than in the former, which, in addition to the extra weight due to the commutator, contributes considerably to the excess of weight of continuous-current machines over induction motors.

The weights of a continuous-current and alternating-current motor for a given rating and speed are not, however, nearly so widely divergent, the continuous-current motor being from 30 to 50 per cent. heavier, and this is due to the

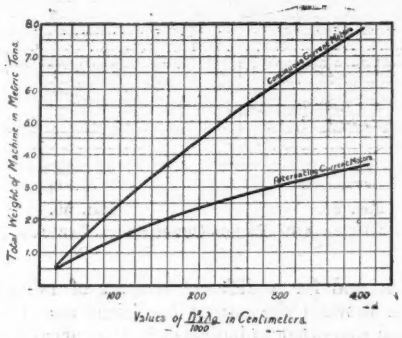

Total Weight of Machine in Metric Tons
Continuous Current Motors
Alternating Current Motors
Values of $\frac{D^2 \lambda g}{1000}$ in Centimetres

Fig. 62.

fact that much higher output coefficients may be obtained with continuous-current motors than with induction motors, which will be seen from the curves for output coefficient already given. Hence, for a given rating and speed, a continuous-current machine will have a considerably smaller value than an induction motor, but, as the specific weight of continuous motors is about twice that of induction motors, the total weights for any particular rating and speed are not so widely different.

It would be an interesting study to compare the relative weights and costs of the various component parts and materials in each of the above classes of machinery.

In concluding the present considerations, it may be pointed out that although the output coefficient is in itself empirical, it may be represented by a rational equation, which is as follows:—

$$\xi = 0{\cdot}182 \times 10^{-8}\ a\beta \text{ for alternating-current machines,}$$

$$\xi = 0{\cdot}16 \times 10^{-8}\ a\beta \text{ for continuous-current machines,}$$

where a = the ampere conductors per cm. of armature periphery,

β = the flux per sq. cm. of total air-gap surface.

These expressions may be deduced from the fundamental voltage equation $V = k\,T\,N\,M \times 10^{-8}$,

where k is 4·00 for continuous-current machines, and is taken as 4·44 for alternators. In the latter case k depends on the ratio of pole arc to pitch and the spread of the winding, and the value of the constant in the above expression for the output coefficient, will vary slightly in proportion to the value of k.

Dr. Thompson, in his Society of Arts Lectures on "High Speed Electrical Machinery," gives the expression for the output coefficient in practically the above form, a being designated the specific electric loading, and β the specific magnetic loading of the armature periphery.

The output coefficient being a Constant $\times\ a\beta$, the results given in this article amount to a study of the product $a\beta$, the two rational factors, although the influence of the rated output, speed, &c., on each of the factors individually, has not been ascertained. The curves given showing the variation in the output coefficient may be interpreted as showing a corresponding variation in either or both of the factors a and β.

The specific loadings, a and β, may be used as a basis for design, and this is the method of procedure adopted in Dr. Thompson's works on dynamo machinery. If such a basis is employed, it is desirable for the designer to know in what cases he may expect to obtain high values for a, and in what cases for β, and the influence of the rated output, speed,

frequency, voltage, &c., on each factor. If the designer has not such knowledge, the curves given above are useful at the outset as showing the general tendencies of the various influences, and the relative values for ξ under different conditions, since ξ may be regarded as the product $\alpha\,\beta$.

The use of the output coefficient ξ is found very convenient to the designer as a starting point, as it is known what value should be attained for any particular case, and by taking a value for ξ from the curves at the first step in the design, he is really fixing a value for the product $\alpha\,\beta$, without assigning them values individually and then working through to $D^2\,\lambda\,g$. Having obtained $D^2\,\lambda\,g$, a value for D may be taken from the curves in figs. 54 and 55, which are based on well proportioned designs showing good results; this fixes D and $\lambda\,g$, and an outline sketch may be prepared. This should preferably be done for two or three alternatives with slightly different values of D. From these an experienced designer can readily tell which design will be the best proportioned. In working out the further stages of the design he will come to settle values for α and β, but it is often possible to vary considerably the values of α and β relative to one another without changing the value of ξ originally chosen. For instance, an alternator which requires close voltage regulation will generally have a lower value for α, but it may in certain cases have the same ξ as a more normal machine.

It would, however, be of very great interest if the variations of the factors α and β were studied with reference to the rated output, speed, frequency and other conditions.

A 60,000-VOLT TRANSMISSION LINE IN AMERICA.

By T. L. KOLKIN.

The *Street Railway Journal* publishes in its issue of July 14th, 1906, particulars of three transmission lines recently completed in America:—(1) The 60,000-volt transmission line of the Syracuse Rapid Transit Co.; (2) the New York Central and Hudson River Railroad transmission line; and (3) the Oneida Railway transmission line.

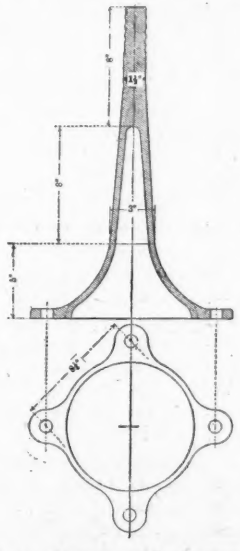


Fig. 1.—Details of Insulator Pin.

Syracuse Transmission Line.—Briefly outlined the new installation at Syracuse embodies the following features:—Electrical energy is generated at the Niagara Falls (Canada) hydro-electric plant of the Ontario Power Co., and is delivered to the transmission lines of the Niagara Falls, Lockport and Ontario Power Co., which is the transmitting company, as 60,000-volt three-phase, 25-period current.

The current is delivered at the city line of the Syracuse Rapid Transit Co. at approximately 55,000 volts pressure, based upon an estimated transmission loss of 8 per cent. The total distance is about 160 miles. From the city limits, the Syracuse Rapid Transit Co. carries the current at this voltage over its own high tension lines to its own rotary converter sub-stations. The power delivered at Syracuse will be utilised by the Syracuse Rapid Transit Co. for operating its traction system. The total power requirement for this purpose is approximately 36,000 KW.-hours per day. The

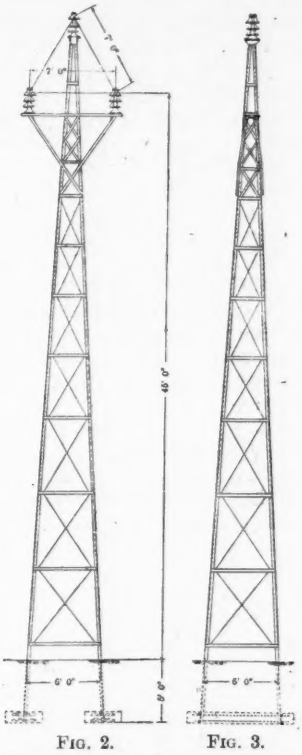


Fig. 2. Fig. 3.

Details of 45-ft. Angle Tower.

transmission line within the city limits of Syracuse crosses a canal twice; it further crosses over three railways and several factories and buildings. The distance from the city boundary to the sub-station is about 9,500 ft.

The line is carried entirely on steel towers, specially designed. There are 40 of these towers on the route, ranging from 45 ft. to 63 ft. in height measured from the ground to the top of the lowest insulator. The total length of the towers is from 55 ft. to 74 ft.

An unusual feature of the work is the use of steel cables for the conductors. Each conductor of the three phases consists of a seven-strand $\frac{7}{16}$ in. plough steel cable. Each cable is strung in one length from the terminal at the sub-station to the terminal at the city line. In a case like this mechanical strength is of greatest importance, and on this account steel conductors were adopted. The average span is approximately 240 ft., the longest single span being 407 ft.

The insulators are designed for 60,000 volts, of the triple-petticoat porcelain type. They are carried on the cross-arms by means of special malleable iron pins, as shown in fig. 1. The pin has a flat base and is bolted to the cross-arm by means of four $\frac{3}{8}$-in. bolts. The parts of the insulators are cemented together, and the insulators are connected by the pins. At the double cross-arm and dead-end towers the cables are clamped to equalising saddles cemented to the top of the insulators.

In designing the line the assumed wind load was taken as $1\frac{1}{4}$ lb. per lineal foot of cable, based on a wind pressure of 30 lb. per ft. on a flat surface, or 15 lb. on a round surface. This is slightly less than we used to reckon in Europe.

The minimum sag allowed was 1 ft. in 40 ft. From a European point of view, this is a rather strange way of specifying the sag. Enough insulators were provided at the angle towers, to prevent the cable from making any angle of over $8\frac{1}{2}°$ on any one insulator. The towers at angles and terminals are designed to provide for the greatest assumed strain.

The design of the towers in general is shown in figs. 2 and 3; the cross-arms were designed to resist torsional strain due to the pull of the cable on the tops of the insulators. The maximum pull allowable was 1,000 lb. for each cable. The cross-arms at the terminals carry three insulators for each cable.

The towers are built up of angle steel with horizontal angles riveted to them. The diagonal rods are adjustable in length by right and left threads at the ends.

Towers of 57 ft. or more are supported on concrete blocks. The footing under each pier is 5 ft. × 3 ft. × 12 in. thick of reinforced concrete. Each leg of the tower is anchored by two bolts running to the footings. For the lighter towers the concrete piers are omitted, and the legs of the tower spliced to angles which extend down into the footings. These are 8 ft. × 3 ft. × 12 in., and reinforced. The angles are each enclosed below the ground line, in a piece of stove-pipe filled with cement to prevent corrosion. The towers were raised and set completely assembled by the use of a tower wagon with a boom 40 ft. long.

The New York Central and Hudson Railroad transmission line.—This company has adopted steel towers for carrying its transmission wires, signal wires, telephone and telegraph lines, &c., within its electrical zone in and near New York City as shown in fig. 4. These towers are built as follows:—

Four angles 3 in. × 3 in. × $\frac{5}{16}$ in.; lacing one angle $2\frac{1}{4}$ in. × $1\frac{1}{2}$ in. × $\frac{3}{16}$ in.; connecting angles $2\frac{1}{2}$ in. × $2\frac{1}{2}$ in. × $\frac{1}{4}$ in.; cap plate of malleable iron; rivets $\frac{3}{4}$ in. diameter. The estimated quantities for one pole are:—Steel, 1,340 lb.; concrete, 6·5 cb. yd.; timber, 71 cb. ft.

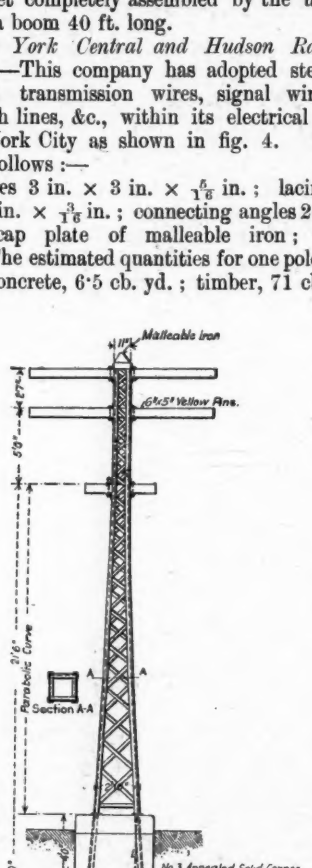


Fig. 4.—Standard Steel Tower of the New York Central Railroad.

The distance from centre to centre of the poles is 150 ft., sag 30 in.; on 1° curve the distance is 141 ft.; on 2° curve 133 ft.; on 3° curve 125 ft.; on 4° curve, 118 ft.; on 5° curve 112 ft.; and on 6° curve 107 ft.

The sag is computed at 70° F. with no wind.

The poles are designed to carry the following wires:—

Six-wire circuit, No. 1, each 0·728 in. diameter, weight 3·66 lb. per linear yard.

Four-wire circuit, No. 2, each 1·5 in. diameter, weight 10·65 lb. per linear yard.

Three-wire circuit, No. 3, each 0·165 in. diameter, weight 0·074 lb. per linear yard, together with $\frac{1}{2}$-in. coating of ice on all wires.

The wind pressure is assumed to be 30 lb. per sq. ft. on the surface of the pole, and on all wires with $\frac{1}{2}$-in. coating of ice.

The poles are to be given one coat of New York Central standard red-lead paint on each surface in contact before assembling, and one coat on the entire pole before leaving the shop. Before erection two heavy coats of New York Central asphaltum varnish are to be added.

Oneida Railway Transmission Line.—This company, for its West Shore electrification, has adopted steel towers of the same type as those used by the Syracuse Rapid Transit Co., described in this article. The standard towers are to be 39 ft. in height from the ground to the top of the bottom insulator. Special towers will be required up to 69 ft. in height from the ground to the top of the bottom insulator. The towers will be set in general at about 480 ft. centres. They will be designed to carry three cables, each of single No. 0 stranded copper. These cables will be strung to a sag of 12 ft. at 32° F.

SOME PRACTICAL NOTES ON THE COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY UNDERTAKINGS.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

The Central Station Magazine.*

Reference has already been made to the Central Station Magazine and its great educational value, which makes it such an important and valuable factor in the equipment of the Commercial Sales Department. Experience has conclusively proved that it can no longer be considered a speculation, so that its adoption has to be seriously considered by every central station.

The ideal magazine should be a high-class production, printed on good quality paper, illustrated with artistic pictures, both coloured and plain, for it is an axiom of advertising that money spent on cheap, ill-displayed printed matter is practically thrown away, as far as the returns obtained through the impressions made by it are concerned. Hence the central station manager who considers the adoption of a magazine is immediately confronted with the apparently high cost of the magazine, which promises to play havoc with his advertising appropriation, and probably not realising the full value of the scheme, is inclined to adopt some other less effective means; but the writer would urge him to take courage and boldly go into the undertaking with the certain result of a surprising and gratifying success, such as is the unanimous experience of all who have boldly adopted and carried out thoroughly this scheme.

Having decided that he will adopt the scheme, the first question that arises is whether to largely defray the cost of publication by the insertion of advertisements. This principle of introducing advertisements has already been referred to in the course of these notes as a moot point.

Undoubtedly the best results, for the quantity distributed, can be obtained by a magazine from which advertisements are entirely excluded, and which is limited to, say, 12 pages, including the covers. Such a magazine should only be sent to a carefully selected list of customers and prospective customers, as otherwise the expenditure would be too great, compared with the returns. To decide against advertisements in a small edition is no great sacrifice, as the limited circulation would hardly appeal to advertisers. Such a list should comprise about 3 per cent. of the population. Of course, should the list be increased to, say, 10 per cent., the number of new customers obtained in proportion to the number of magazines distributed would be not nearly so great, but, on the other hand, the actual gross number of new customers would be larger.

In support of making the list about 10 per cent. of the population, it should be remarked that this circulation would

* Previous articles of this series appeared on pages 650-1, 656-7, 827-9, 808-9, and 849-850 of the current volume.

cover nearly half the reading public. Obviously the ultimate effect is that a larger number of people would be gradually educated to consider central station power as one of the necessities and conveniences of life, which will remove much opposition to the better lighting of the streets, and also in proportion as things electrical become of more general interest, it will bring the matter more effectively home to those more enterprising and well-to-do people who are hesitating on the verge of decision as regards an electric installation in either their homes or their business premises.

While the conclusions drawn here point to the exclusion of advertisements from a small select list as being both unobtainable and undesirable, the question of the larger circulation such as has been suggested is very different. The burden of expense incurred by more than trebling the issue of the magazine must be lightened by the welcome aid of the advertiser, who thoroughly appreciates the value of a publication with the circulation suggested.

The question of the insertion of advertisements cannot be fully considered until the general scheme of the preparation of the contents has been decided upon. With the possible exception of very large cities, the only practical method within the bounds of economy, is to employ a localised magazine of the type prepared for that purpose by various publishers, since an entirely local production would be prohibitive if the illustrations and reading matter were to be of the highest class. Even in towns of medium size the services of a specialist in the art of electrical journalism, would prove too costly, and it does not pay to have this work done by a responsible official of the central station, as he could probably use his energies to much greater effect in connection with his ordinary duties. Taking the question generally, it would seem that the best solution is a magazine edited by experts, with one or two pages of local notes and a localised title. If this plan were very largely adopted the support of those who advertise in the popular magazines could be obtained; the local advertiser would soon follow, also the electrical manufacturer.

The central station manager, in some instances, when he finds his advertisements coming in slowly, is only too apt, like all other advertising agents, to fall back on those sources where he finds he can bring a little pressure to bear, viz., the electrical manufacturers; which is, of course, regrettable if done in that spirit alone. Doubtless in many instances he considers he is doing a service to the advertiser, especially as the latter generally takes the matter up so promptly, without the need of much persuasion. Evidently, however, from the appearance of advertisements in existing magazines certain of the electrical manufacturers who advertise therein have only done so as a matter of courtesy and for the purpose of retaining the goodwill of the local management. The letters published recently in the "Correspondence" columns of the ELECTRICAL REVIEW from publicity managers, confirm this. Now while there is a great deal to be said from their point of view, it must be agreed that if in some way they can assist the manager of a central station in the development of his undertaking, they should do so, as they will benefit thereby indirectly, and more or less immediately according to the type of apparatus they supply; for example, makers of lamps, insulated wire, lighting fittings and heating apparatus feel the benefit first, owing to the increased demand.

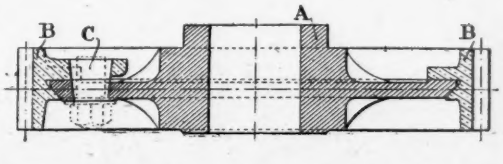
It must be remembered that every support and assistance that can be rendered to a central station manager in the increasing of his sales, means an increase in the demand for electric light and power and a corresponding demand for the goods of electrical manufacturers. The feeling on this point has grown so strongly in the United States that the Co-operative Electrical Development Association has been formed there, to encourage and develop in every possible way the more extensive use of electricity. The principal source of income of the association is from the electrical manufacturers, who are setting aside the sum of one-tenth of 1 per cent. of their sales income for that purpose—to such an extent do they feel that they are being reimbursed.

Having taken the space, the Manufacturers' Publicity Departments often waste a space which they could turn to some account if they only arranged their advertisements better to suit their readers. The whole subject of advertising in these local magazines is one which, as has been suggested by a correspondent, it would be well thoroughly to discuss before a meeting of managers of Electrical Publicity Departments. There are certain direct advantages to be obtained by advertising in these publications; for example, a man who has regularly received the local electrical magazine, and whose eye has, perhaps unconsciously, noticed from month to month the name of a certain firm, is likely, when he has decided to adopt electric light or power, to prefer the lamp or motor supplied by that firm in preference to some other he has never heard of.

It will be noticed that electric lamp manufacturers are already beginning to advertise in the daily newspapers (appreciating the fact that a larger and larger section of the general public is becoming interested in their line of goods), and why should they not advertise in electric supply magazines? The gas industry has advertised assiduously for years, while the electrical industry is seriously underadvertised and underexploited in comparison. It would be unprofitable to fix the responsibility on any particular branch of the industry. In the spirit of co-operation, however, let it be assumed, as is doubtless the case, that we are all in greater or less degree responsible for any conditions, prosperous or otherwise, which exist, and mutually interested in any proposition promising improvement.

GEAR WHEEL WITH REMOVABLE TOOTH RIM.

A GEAR wheel of the type shown below has been designed by Mr. J. H. Fogarty, for the purpose of simplifying the replacement of worn-out wheels on electric tramcars. As usually arranged, the whole wheel (generally made in two halves) has to be discarded as soon as the teeth are worn out. With the new arrangement the wheel consists of a permanent hub A, in one piece, mounted once



for all on the axle, and to this hub two semi-circular crowns of teeth B are attached. The attachment is securely effected by turning the rim of the hub conically, as shown, and drawing the rims (which are conically recessed) into position by means of the conical bolts C. Each semi-circle of teeth is provided with two lugs bored to take such bolts.

All the parts are machined exactly to gauge, so that when a set of teeth is to be replaced, it is only necessary to remove the four bolts and to substitute a new pair of toothed rims—an operation which only takes a few minutes.—*Le Génie Civil.*

Electric Rays and Eyesight.—The attention of the Berlin Medical Society was recently drawn by Dr. Erzellitzer to his observations in regard to injuries caused by electric rays in a large works in that city, where welding experiments are at present in progress. It appears that a process of welding steel by the use of the electric arc is being tested. The experiments have been carried out in a detached part of the works, and by accident about 30 workmen had to pass the spot one afternoon at a distance of about 16½ ft. from the welding apparatus, the men looking at the arc without approaching nearer. At the time no complaints were made, but during the night all the 30 men awakened with violent pains in the eyes and were unable to open the lids. Next morning the eyes were swollen and very painful and sensitive to light. An examination showed that the men were suffering from inflammation of the eyes, and the doctor concludes that the injuries were produced not by the red heat rays but by the so-called chemical ultra-violet rays. Although all the men have recovered from their temporary injuries, it is considered that the danger to the eyes through ultra-violet rays should not be under-estimated. The engineers and other men who are directly concerned with the experiments use protective helmets during the process, but even under those circumstances, they have to suspend work after a short time, as otherwise pains arise in the eyes and head.

A NEW GUTTA BALATA.

In the journal *Le Caoutchouc et la Gutta-percha*, for October 15th, there is a technical description of a new gutta balata, which is prepared by an inventor through purification of the commercial balata gum, by means of a secret process.

As the inventor considers it may be substituted for pure gutta-percha in cables, besides having other uses in the rubber industry, a description may prove of interest to readers of the Electrical Review.

The substance has been submitted to two chemists for analysis, with the following results :—

Gutta-percha	76·20
Resins	9·20
Water	2·10
Insoluble residue	12·50
	100·00

The only difference in the second chemist's analysis is that the resins come out 8·83. The ratio of gutta to resin is about 8·5, which seems to compare favourably with the various substances given in Obach's "Die Gutta-percha," p. 60. If one looks at Obach's table he will notice that this ratio varies from 1 to 43. It appears, therefore, that in the process of manufacture much of the gum, about a third, is eliminated, so that the new substance is comparable with the very best guttas.

The samples submitted have a greyish red appearance, a soapy feeling when touched, and a different odour to that of gutta-percha. It begins to soften at a temperature of about 50° C., dissolving at about 75° C., and at this temperature can be pulled into the finest threads. It is not very sticky, and dissolves in solvents more slowly than gutta-percha.

Good gutta-percha should also set or solidify rapidly, so that when being rolled on to a drum after coating a wire it may not be destroyed mechanically for insulation purposes. The new material has been carefully examined from this point of view in the following way :—

Small spheres of the gutta-percha and gutta-balata to be tested are made of approximately the same dimensions; they are then softened by water almost at the boiling point. Into the sphere is now inserted the bulb of a fine thermometer, the gutta-percha entirely surrounding it. It is then placed inside a glass vessel to shield it from draughts of air, and the rate of lowering of the temperature noted. A time registering apparatus enables the curve of cooling to be obtained with accuracy.

It appears that pure gutta-percha without resin, when cooling, reaches at about 30° C. a point where there is very little temperature change for some time. This is the commencement of the hardening process, and it is somewhat analogous to the process of solidification of a salt solution, but, of course, gutta-percha has between its melting and hardening an intermediate more or less plastic state. In this it resembles some irons, and other metals which soften before melting. It appears that this "point d'arrêt" is so connected with the purity of the substance that impure guttas can be detected at once by means of a cooling experiment of the above nature. Impure gutta-percha remain plastic for a long time, and show but a slight indication at 30° C. It appears also from this test that the new gutta-balata is classed with the best guttas.

The material has also been tested in the Laboratoire Central D'Electricité, Paris, for specific resistance and specific inductive capacity.

The method of testing the specific resistance was that of direct deflection, tinfoil electrodes being pressed on a slab of the substance and 200 volts applied. The values found were 200 million megohms at 22° C. and 20 megohms at 70° C. after one minute's electrification.

Hospitalier indicates that the specific resistance of gutta-percha varies between 25 and 500 million megohms, the latter figure being obtained for the very purest samples. It varies with the temperature, pressure, and duration of the electrification. For manufactured material, as used in cables, one expects about 200 million megohms.

A condenser was also made having the substance as dielectric, and the specific inductive capacity found was about 3. The values given in Obach's tables vary from 2·7 to 4·49 for gutta-percha, so that the figure obtained appears satisfactory.

Nothing, however, appears to be stated regarding the duration of charging the condenser, or whether any of the substance was tested for absorption effects, a matter of some importance.

It would also be interesting to see whether the material resists rupture under a high alternating P.D., and to know whether or not it absorbs moisture to any extent. The latter might easily be tested by immersing a sample in water, and weighing it carefully at definite intervals of time.

The material has also been tested for tenacity and extensibility by means of a special dynamometer, and the deformations under increasing loads measured up to the point of rupture. The extensions were measured between two marks on the sample, and not between the jaws of the apparatus as in Obach's experiments, since owing to slipping of the sample in the jaws, these are open to objection.

The results of the traction experiments show that the gutta balata compares with the purest samples of guttas, and is very superior to the impure varieties. These samples also had been tested and flattened without intense compression, so that in all probability if they had been so treated the results would have been much higher.

The hydrates of sodium and potassium, and hydrochloric and acetic acids, have no action on the material. Sulphuric acid makes it brown, but only dissolves it slowly. A thin sample left for two months on a window sill exposed to the weather has lost its rose colour and soapy feeling, but still retains its suppleness.

Compounds have been formed with india-rubber. These contain from 8 to 40 parts of the new gutta balata mixed with 82 to 50 parts of Para rubber, 10 per cent. of sulphur being added in all cases. A table of tests is given, showing the resulting mixture to have enormous tenacity compared with india-rubber, this increase exceeding 400 per cent. By heating the different mixtures in boiling water, and noticing whether they soften or retain their properties, it is shown that apparently a true compound is formed with the rubber.

It seems that india-rubber vulcanised with the new gutta-balata, even with 40 per cent. of the latter, increases in tenacity and extensibility, without any increase in weight. One can manufacture with mixtures of this sort extremely pliable substances, and they can be sold at from 15 to 20 fr. the kilogramme, according to the quality of the rubber used in the mixture.

Gutta balata can also be mixed alone with sulphur. These mixtures have an increased elasticity up to 30 per cent. of sulphur, and the hardness increases up to 40 per cent.

Apparently a substance possessing so many valuable properties will be largely used in cable manufacturing and in the rubber industry.

Those interested are invited to write to M. Domède, 3, Rue Manuel, Paris, who is the inventor of the process.

A Tramway Recreation Club.—A recreation club has recently been formed by the Walthamstow tramway employés. A spacious hall in the depôt has been placed at the service of the club by the Tramways Committee, and this is being used as a combined reading room and gymnasium. Arrangements have been made for a regular supply of newspapers and magazines, and concerts, debates and lectures will form prominent features for the coming winter. The first smoking concert in connection with the club was held on Wednesday evening, the 14th inst., at the Depôt Coffee and Dining Rooms, Chingford Road, at which there was a large attendance. The chair was taken by Mr. C. J. Wilkes (Chairman of the Tramways Committee), supported by Mr. J. H. Sansom and Mr. W. Murray (tramways manager).

An Aberdeen Lawsuit.—In our issue of November 9th, p. 758, a lawsuit was reported between the British Westinghouse Electrical and Manufacturing Co., Ltd., and the Aberdeen Corporation. We are asked to point out in connection with this notice that the action in question was taken by the British Westinghouse Co., as main contractors to the Corporation, at the instigation of Messrs. Willans & Robinson, Ltd., of Rugby, their sub-contractors for a reciprocating engine of 750 kw. The difference between Messrs. Willans & Robinson, Ltd., and the Aberdeen Corporation arose in connection with certain defects which the Corporation argued had developed in a cast-iron fly-wheel, and Messrs. Willans and Robinson, Ltd., whilst disagreeing with the view taken by the Corporation, claimed arbitration under an arbitration clause in the contract. We are asked to make clear the fact that the lawsuit was brought at the instigation of Messrs. Willans & Robinson, Ltd., and not at that of the British Westinghouse Co.

A NEW METHOD OF MEASURING SPEED IRREGULARITIES.

In the case of alternators running in parallel, serious trouble is sometimes introduced by the fact that the speed of one or of both machines is not perfectly uniform from instant to instant. It is especially important in this respect to know the maximum difference between the positions of the two armatures relatively to corresponding poles, *i.e.*, the maximum difference in the phases of the voltages of the two machines. Many more or less satisfactory methods of measuring and recording this comparatively small fluctuation have been devised from time to time, but the following

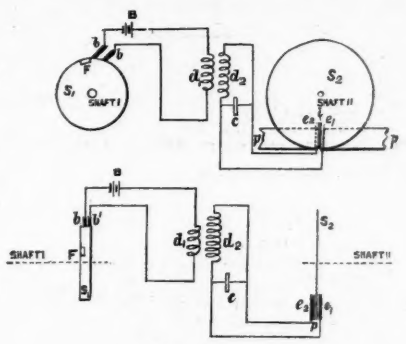


FIG. 1.

arrangement, due to Herr G. Huldschiner, would appear to have some distinct advantages over the older methods. The connections employed are shown diagrammatically in plan and elevation in fig. 1. In order to avoid all pen friction, the record is made by means of an electric spark passing through a sheet of paper. On the spindle of one of the two alternators a brass contact disk s_1 is mounted, with a small piece of fibre F let in at one point of its periphery. On this disk two brushes b b rub and, normally, close the primary circuit of a small induction coil d_1 d_2. For an instant in each revolution, when the brush comes to the piece of fibre, this circuit is interrupted, and at this instant, consequently, a spark is produced between the secondary terminals of the induction coil. These secondary terminals are formed of two thin brass strips e_1 e_2 separated by the recording paper p, and by an insulation (paraffined cardboard) disk s_2 attached to the shaft of the second alternator. This disk is pierced by a specially shaped slot i inclined to the radius of the disk, and it is through this slot (at a height depending on the relative positions of the slot, and the strips e at the instant when the circuit is broken at b) that the recording spark passes. If the paper is drawn past the strips by hand a continuous record will be produced by the action of the successive sparks. Supposing

FIG. 2.

the two alternators are running exactly synchronously, the disks will always occupy the same relative positions at the instants when the brushes b, b cause the sparks to pass, and the record will be a straight horizontal line. If, however, hunting is taking place the instants at which the circuit is broken by disk s_1 will correspond with various positions of disk s_2, and so various points of the inclined slot will be opposite the strips e_1, e_2, and the successive sparks will pass at different heights, and form a wavy curve as shown in fig. 2. In such a curve it is only the height or amplitude of the waves which is of importance; the horizontal scale depends only on the speed at which the paper is drawn past, and this cannot, of course, be quite uniform if done by hand.

The shape and slope of the slot in disk s_2 is of importance. The less its deviation from the direction of a radius the more sensitive will the arrangement be (the greater the amplitude of curve produced by a given irregularity). In order that amplitude of wave shall accurately represent angular deviation between the two alternators, it is essential that the increase of length of radius measured from the centre of the disk to the point of intersection with the slot shall be proportional to the increase in angular distance between the radii, *i.e.*, in fig. 3 ρ must equal $r \pm a\phi$ where r = radius at angle 0°, ρ = radius at angle ϕ, and a is a constant determining the slope of the slot. [In fig. 1 the slot is shown radial instead of sloping, and in fig. 3 $a\rho$ should be $a\phi$.]

In practice the disk s_2 is provided with several slots of various slopes, and representing various ranges of measurement. By moving the brushes b, b round disk s_1, any desired one of these slots can be brought into action.—*Der Elektrotechniker*, September 1st and 15th, 1906.

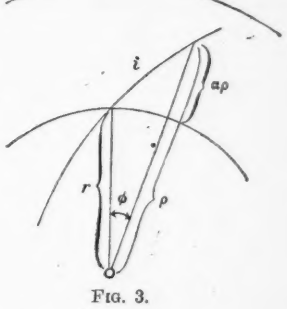


FIG. 3.

Electric Smelting of Iron Ore. — A furnace described in *Electro-chemical and Metallurgical Industry*, Vol. IV, No. 7, was designed by Dr. P. L. T. Héroult; it consisted essentially of an iron casing containing a copper strip to prevent inductance, and bolted to an iron base. The bottom was covered with carbon paste and the sides were lined with fire-brick containing a carbon paste face. The electrodes were manufactured by the Héroult process in Sweden, and had the dimensions 16 in. × 16 in. × 6 ft. The contact with the cable consisted of a steel shoe riveted to four copper plates, which ended in a support for a pulley. The electrode was supported by a chain working over a winch. The electrical energy was supplied by one phase of a three-phase 400-KW., 30-cycle, 2,400-volt alternator, and was delivered at 2,300 volts to a 225-KW. oil-cooled transformer which lowered the voltage to 50 volts. Attempts were made to use the calorific energy of the carbon monoxide, but without complete success. The pig-iron produced has a very low phosphorus content. The E.H.P.-years consumed per ton of pig were 0·276 for magnetite containing 55·85 per cent. iron.

Passivity of Iron.—In a paper recently read before the American Chemical Society, C. McC. Gordon and F. E. Clark discuss the question of the passivity of iron. If the view be retained that iron becomes passive under certain circumstances because the metal is covered with a film of oxide, the iron should behave like an electrical condenser, an insulating layer of oxide lying between the metal and the solution, which are both conductors. The authors have accordingly examined the behaviour of passive iron electrodes in various solutions, measuring their capacities against that of a metallic condenser of known capacity by means of a Wheatstone bridge. They find that the passive electrodes possess an easily measurable capacity, whereas active electrodes, *e.g.*, iron in dilute nitric acid, and freshly deposited electrolytic iron, show no sign of such capacity; that the capacity is of approximately the same magnitude as the capacity of aluminium, which is known to be covered with a film of oxide; and that an electrode oxidised in a Bunsen flame exhibits a capacity of similar value. The oxide film produced by heating in a flame is five or six times as thick as that formed on iron when rendered passive by treatment with concentrated nitric acid. It is also characterised by possessing a low resistance, *i.e.*, the metal behaves like a leaky condenser. Hence passive iron does behave as though coated with a layer of oxide. The authors also find that iron which has been exposed to air and then introduced into a neutral solution behaves qualitatively in the same fashion as iron oxidised in a flame. Its capacity is somewhat greater than that of passive iron, and its resistance is rather smaller; this, in the authors' opinion, being due to minute cracks or openings in the oxide coating.

Telephotography.—According to the Berlin correspondent of the *Tribune*, Prof. Korn, of the Munich University, has succeeded in sending photographs and sketches 6 or 7 in. square from Munich to Nuremberg in from 10 to 15 minutes. The photograph is placed on a transparent glass cylinder, which revolves slowly and at the same time moves from right to left. A ray of light is thrown on the cylinder by means of an electric lamp and lens, and when the ray reaches the interior of the cylinder it is brighter or darker according to the colouring of that particular part of the photograph through which it passes. Inside the cylinder is some selenium, which varies an electrical current passing through it in proportion to the intensity of the light brought to bear on it. The receiving apparatus consists of a Nernst lamp placed inside a glass cylinder covered with sensitised paper, on which is reproduced the photograph in its exact shades, provided that the cylinders at each end of the wire revolve at exactly the same speed. It is hoped to make such improvements in the apparatus as will enable pictures to be photographed in two minutes.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

24,061A/05. "Improvements in electric arc lamps." H. Blvis and A. E. Angold. (Date applied for under Rule 5 of the Patents Rules, 1905, November 22nd, 1905.) November 17th.

25,429. "Combined terminal and switch for attaching to sparking plugs of internal combustion engines." W. F. Kelly. November 12th.

25,436. "Improvements relating to electrical switches." D. K. Morris and G. A. Lister. November 12th.

25,489. "Improvements in a process of electrolytically extracting metals rom ores." M. Pepreur-Lloyd and A. M. Gardner. November 12th. Comp'ete.)

25,501. "Improvements in and relating to electro-magnetically-operated valves." E. L. White and E. C. Hoegerstaedt. November 12th.

25,508. "Improvements in electric fire alarms." W. Matzka and W. Timmermann. November 12th. (Complete.)

25,509. "Improvements in and connected with fuse plugs." W. Matzka and W. Timmermann. November 12th. (Complete.)

25,557. "Improvements in track brakes for electric tram-cars and the like." Mountain & Gibson, Ltd., and A. F. H. Head. November 13th.

25,558. "Improvements relating to electric light and gas shades for advertising and other purposes." A. B. Gregson and A. J. Millichip. Novenber 13th.

25,560. "Roller catcher for trolley wires." E. A. Anderson. November 13th.

25,569. "Improvements in electric block signals." G. P. Finnigan. November 13th. (Complete.)

25,598. "Improved method of operation of pumps and magnetos connected with explosion motors." J. Spyker. November 13th.

25,599. "Improvements in electric furnaces." A. Reynolds. November 13th.

25,609. "Device for locating submarine mines and for cutting the cables thereof." A. A. Stohr. November 13th.

25,622. "Improvements in electrodes for electric arc lamps." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitats-Gesellschaft, Germany.) November 13th.

25,627. "Improvements in switch releasing mechanism for coin freed electricity meters." J. M. Tourtel. November 13th.

25,632. "Improvements in or relating to magneto-electric generators." J. A. Williams. November 13th. (Complete.)

25,678. "Improvements connected with arc lamps." T. McClelland, Jun., and C. Kratt. November 14th.

25,685. "Improvements in fuse heads for electric blasting." F. Render. November 14th. (Complete.)

25,753. "Improvements in and relating to electric motor control systems." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) November 14th.

25,761. "Improvements in or connected with accumulator cells." H. Leitner. November 14th.

25,770. "Improvements in tremblers of induction coils." Electric Ignition Co., Ltd., and F. H. Hall. November 15th.

25,788. "Improvements in and relating to electric light fittings." C. C. Sugden. November 15th.

25,795. "Improvements in or relating to electric ignition devices as used in connection with internal combustion engines." M. B. Field. November 15th.

25,818. "Photo telegraphone." G. C. Geisler. November 15th.

25,834. "Elastic high tension cable for conducting electricity." A. H. Pirie. November 15th.

25,863. "Improvements in and relating to current collecting devices for electrically-propelled vehicles." The British Thomson-Houston Co., Ltd. General Electric Co., United States.) November 15th.

25,877. "Improvements in magneto-electric machines more especially intended for effecting sparking for the ignition of the explosive mixture in internal combustion engines." A. de Saint-Roman. (Date applied for under Patents Act, 1901, May 25th, 1906, being date of application in France.) November 15th. (Complete.)

25,891. "Improvements in electric switches." W. J. Addison. November 16th.

25,981. "Improvements in or in connection with electric ignition devices for use in connection with internal combustion motors." L. E. Wilson and F. M. Birtill. November 16th.

25,988. "Improvements relating to electro-mechanical transmission devices." M. Johannet. (Date applied for under Patents Act, 1901, December 4th, 1905, being date of application in France.) November 16th. (Complete.)

25,991. "Improvements in electric furnaces." Maschinenfabrik Oerlikon, Gottlieb Wuthrich and E. Stirnimann. November 16th.

25,992. "Improvements in electric furnaces." Maschinenfabrik Oerlikon, Gottlieb Wuthrick and E. Stirnimann. November 16th.

25,994. "Process for the soldering of incandescence filaments of electric incandescence lamps to the conducting wires." H. Kuzel. (Date applied for under Patents Act, 1901, January 20th, 1906, being date of application in Germany.) November 16th. (Complete.)

26,040. "Improvement in ignition and portable accumulators (electric)." A. Shepherd. November 17th.

26,055. "Improvements in electric arc lamps." H. S. Hatfield and F. M. Lewis. November 17th.

26,066. "Improvements in and relating to trucks for electrically-propelled vehicles." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 17th.

26,086. "Improvements in electrical winding mechanism for clocks." J. Simeon and J. Besancon. November 17th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Manufacture of Incandescent Electric Lamp Filaments from Thorium. British Thomson-Houston Co. (General Electric Co.) 14,972A. July 20th. (Date applied for under Rule 5, Patents Rules 1905, July 20th, 1905.)

Electro-Capillary Apparatus. E. Oldenbourg. 19,425. September 26th.

Magneto-Electric or Electro-Magnetic Machines for Use in Automobiles and for other Purposes. J. A. E. Pellorce. 21,248. October 19th.

Method and Means of Hermetically Sealing a Wire or Metallic Electric Conductor, or other Substance through or into Vitreous Substance, such as Lead, Jena, or Quartz Glass. C. O. Bastian and G. Calvert. 21,383. October 20th.

Electrical Switches. Electric & Ordnance Accessories Co. and R. F. Hall. 21,485. October 23rd.

Selective Signalling Apparatus, Applicable for Telephonic and other Purposes. J. D. F. Andrews. 21,565. October 24th.

Vacuum Tube or Apparatus for the Production of Violet or Ultra-Violet Rays, X-Rays, or other Rays or Combination of Rays, by Induction on Low-Tension Currents. J. C. Bowie and J. H. Fields. 21,604. October 26th.

Manufacture of Hypochlorite Solutions by Electrolytic Methods. W. P. Digby. 21,949. October 28th.

Supporting and Mounting of the Shafting of Ships' and Analogous Telegraphic Apparatus. A. V. Grant. 21,976. October 28th.

Braking Polyphase Induction Motors. H. Braun. 22,195. October 31st.

Iron-free Variable Inductances. G. F. Mansbridge. 22,206. October 31st.

Apparatus for Controlling the Supply of Electric Energy from Alternating Current Electric Generators to Alternating Current Electric Motors. R. S. McLeod. 22,231. October 31st.

Incandescent Electric Lamps. British Thomson-Houston Co. (General Electric Co.) 23,427. November 17th.

Electric Resistances. British Thomson-Houston Co. (General Electric Co. 24,855. November 30th.

Switchboards. C. K. Mills. (M. Vitous and W. P. Hammond.) 25,131. December 4th.

Electric Telegraphy. E. Raymond-Barker. 25,866. December 12th.

Electric Arc Lamps. B. M. Drake, A. D. Jones and Jandus Arc Lamp and Electric Co. 26,854. December 23rd.

1906.

Electric Ignition Gear for Explosion Engines. L. A. Gianoli. 9,203. April 18th. (Date applied for under International Convention, April 20th, 1905.)

Telautographs. F. Ritchie. 11,956 and 11,957. May 22nd.

Fittings for Supporting or Carrying Electric Lamps. J. Dugdill. 12,061. May 23rd.

Apparatus for Administering Hydro-Electric Baths. G. A. Knothe. 16,176. July 17th.

Secondary Batteries or Accumulators. E. H. Schneider. 18,665. August 18th.

Suspended Electric Railways. F. E. D. Acland and B. Greiff. (A. Bleichert and Co.) 2,787. February 5th.

Condensers for Wireless Telegraphy and other Uses. W. W. Massie. 4,220. February 20th.

Electro-Magnetic Playing Device for Keyboard and other Musical Instruments. F. Schubbe. 12,135. May 24th. (Date applied for under International Convention, May 25th, 1905.)

Push Button Control Systems for Electric Elevators. W. Sprowson, A. S. Hall and W. G. Burn. 12,233. May 25th.

Suction or Pressure Air Nozzle for Cleaning out Plug-Holes of Telephone Installations and the like. A. Serenyi. 12,937. June 2nd. (Date applied for under International Convention, June 2nd, 1905.)

Electric Switches. E. Neudorffer. 13,337. June 9th.

Junction Box for Electric Cables. T. B. Reader. 14,910. June 30th.

Electric Fuses for Blasting. F. Render. 17,026. July 28th.

Apparatus for Protecting Electric Circuits against Excessive Current Strengths. Siemens Bros.' Dynamo Works. (Siemens Schuckert-werke Ges.) 17,166. July 30th.

Price Advance in Austria.—The Association of Austro-Hungarian firms who are engaged in the production of articles comprised under the heading of light electrical engineering apparatus and appliances announce a fresh advance in prices. In July an increase from 10 to 15 per cent. took place, and as a result of the further rise in the cost of raw materials it has now been decided to advance the 15 per cent. to 20 per cent. The associated cable factories, which acted in a similar manner in July, have also made an addition of 5 per cent., making a total increase of 20 per cent. for the present year.

A Colliery Plant Breakdown.—At the Silverwood Pit of the Dalton Main Colliery Co. there was recently a breakdown of the engine portion of the electric generating plant, which rendered necessary the ordering at once of a 300-kw. alternating-current generator and exciter. A quick delivery was the chief condition, and the British Westinghouse Co. gave a delivery within 14 days, the time under contract.

Temperature of Formation of Carborundum, &c.—S. A. Tucker and A. Lampen have recently made some measurements of the temperatures of formation and decomposition of carborundum, the crystalline silicon carbide, and also of the formation of siloxicon, the amorphous silicon carbide, using a specially designed experimental electric furnace, and an optical pyrometer. In two tests the temperature of formation of carborundum was found to be 1,920° C. and 1,980° C., and the temperature of its decomposition into graphite 2,218° C. and 2,223° C. The temperature at which the amorphous carbide changed into the crystalline variety was, on an average, between 1,950° and 2,220° C. When carborundum is manufactured in an electric furnace of the usual type, the product is sharply separated into layers of graphite, carborundum, and siloxicon; but the boundary between the carborundum and the siloxicon is less distinct than that between the carborundum and the graphite.

In some further experiments with a resistance furnace (carried out by Lampen only), a mixture of three atoms of carbon and one molecule of silicon reacted to form silicon carbide at about 1,600° C., the substance became crystalline between 1,900° and 2,000° C., and decomposed between 2,200° and 2,240° C. A mixture of three atoms of carbon and one molecule of calcium oxide (lime) yielded no calcium carbide at 1,700°, a little at 1,725°, and a considerable quantity at 1,740° C. Fireclay was unchanged at 1,350°, but melted at 1,400° C.; firebrick melted partially at 1,550° and completely at 1,600° C. Dresden crucible porcelain softened at the corners at 1,600°, and melted at 1,650° C. Pure quartz softened similarly at 1,650°, and melted at 1,700° C. A magnesia brick, containing much iron, softened at 1,900° and melted at 2,000° C.